*IMPERIAL INSTITUTE*

# INDIAN TRADE ENQUIRY

## DRUGS AND TANNING MATERIALS

## REPORTS ON CINCHONA BARK AND MYROBALANS

*IMPERIAL INSTITUTE*

**REPORTS of the INDIAN TRADE ENQUIRY**

HIDES AND SKINS
RICE
OIL-SEEDS
RESINS
JUTE AND SILK
TIMBERS AND PAPER MATERIALS
DRUGS AND TANNING MATERIALS
(CINCHONA, MYROBALANS)

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# REPORTS ON CINCHONA BARK AND MYROBALANS

LONDON
JOHN MURRAY, ALBEMARLE STREET, W.
1922

# IMPERIAL INSTITUTE

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# PREFATORY NOTE

## To Reports of the Indian Trade Enquiry

In August 1916 the Secretary of State for India invited the Imperial Institute Committee for India to conduct an enquiry into the possibilities of further commercial usage in the United Kingdom of the principal Indian raw materials. It was also proposed that the enquiry should include the possibility of the usage of these materials in other parts of the Empire.

The invitation was accepted by the Committee for India, and a number of Special Committees were formed to deal with the principal groups of materials selected for inclusion in the Indian Trade Enquiry.

The groundwork for the consideration of the various Committees has been supplied from the information as to the raw materials concerned, which has been systematically collected at the Imperial Institute, chiefly in the Scientific and Technical Department and in the Technical Information Bureau.

The Committees have also had at their disposal the numerous reports made by the Scientific and Technical Department of the Institute during recent years on the composition and commercial uses and value of Indian raw materials, and have also utilised the collections of raw materials of India derived partly from Technical Departments in India and partly from commercial sources which are included in the Indian Section of the Public Galleries and in the Reference Sample Rooms of the Institute.

It has now been decided by the Secretary of State that, subject to certain reservations, the reports of these various Committees which have been forwarded by the India Office to the Government of India shall be published.

The reservations referred to are that, at the request of the Government of India, paragraphs in certain of the reports as presented should be omitted, such paragraphs being indicated by asterisks, and that it should be stated that the reports represent the personal opinions of the members of the Committees, and that the Secretary of State is in no way committed to accept these opinions.

C. C. McLEOD,
*Chairman, Committee for India.*

*November* 1919.

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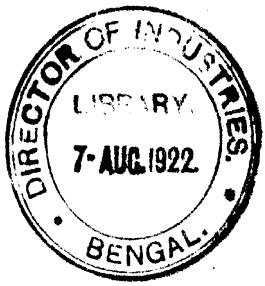


# DRUGS AND TANNING MATERIALS

## REPORTS ON CINCHONA BARK AND MYROBALANS

### I

### REPORT ON CINCHONA BARK

After considering the various materials which form the more important items in the drug trade of India, the Special Committee decided that, having regard to the present conditions of the world's trade in cinchona bark and to the great importance of this drug to the British Empire, and especially to India, it was desirable to give priority to cinchona bark, and they have accordingly dealt with this material first. They have considered fully the somewhat voluminous literature, which exists especially in Dutch, on all aspects of cinchona bark cultivation, production, trade and utilisation, and they have been materially assisted in their investigations by the information freely placed at their disposal by experts in cinchona cultivation, and by traders and manufacturers who are dealers in or users of the bark. They would especially thank in this connection the Hon. C. H. Strutt, Chairman of Anglo-Dutch Plantations of Java, Ltd., Mr. W. H. Standen, lately Director of Government Cinchona Plantations, Madras, Mr. C. N. Woodhouse, of Messrs. C. N. and C. Woodhouse & Co., and Mr. D. Lloyd Howard, of Messrs. Howards & Sons, Ltd.

#### World's Production of Cinchona Bark

As is well known, the original source of supply of cinchona bark was South America, where the cinchona species are indigenous in the forests of the Andes between 10° N. Lat. and 19° S. Lat. Small supplies of bark are still

obtained from these areas, though the latter have long since ceased to yield quantities which can be regarded as important in comparison with the output from Java. Cinchona species were introduced into British tropical possessions about 1860, and twenty-five years later Ceylon became the world's principal source of supply of the bark and maintained this position for a time until it began to be supplanted by Java, which country now contributes about 90 per cent. of the world's annual supply of cinchona bark. India's output has never been large; it probably reached its maximum with about 4,000,000 lb. of bark in 1899–1900, and is now about 2,000,000 lb. per annum. These figures refer to total output in the countries concerned and not to the exported surplus, with which output is sometimes confused.

It is not easy to estimate the world's annual output of cinchona bark, because the producing countries do not, as a rule, publish figures for their output, but only figures for export of bark. The following estimate of total output has been prepared at the Imperial Institute after a careful consideration of all the data available:

| | lb. |
|---|---|
| Java | 23,000,000 [1] |
| India | 2,000,000 |
| Other countries | 400,000 |
| | 25,400,000 |

So far as Java is concerned, the figure given is the estimated annual output during the period 1911–13; for India the figure relates to the years 1912–13 to 1915–16, whilst for "other countries" the figure is for 1910, the last year for which complete figures for all "other countries" could be obtained. Details of the export trade of the Netherland East Indies in cinchona bark and quinine during the years 1911–1917, according to the official trade returns, are given in Tables VI and VII appended to this Report.

[1] *This estimate is based on the figures for the exports of bark and quinine published in the Diplomatic and Consular Reports on the Netherland East Indies. These figures are higher than those recorded in the Netherland East Indies Official Trade Returns, but are practically identical with those given in a pamphlet on cinchona, published by the Java authorities in connection with the San Francisco Exhibition* (1914).

Figures for these different years have been taken because in the opinion of the Committee they most probably represent the outputs which may reasonably be expected from the various countries during the next few years.

According to this estimate, Java produces about 23,000,000 lb. of bark out of a total world's production of 25,400,000 lb., or about 90 per cent. The next most important producer is India, with about 2,000,000 lb., or about 8 per cent. The most striking feature of the trade in cinchona bark is therefore the virtual monopoly held by Java, a monopoly which, moreover, has been secured at the expense of Ceylon and India, and which makes the British Empire ultimately dependent on a foreign country for the raw material from which the essential drug quinine is made.

This position has long been known by those interested in this trade, and its disadvantages to the Empire realised. In the memorandum on the Supply of Essential Drugs furnished by the National Health Insurance Commission to the Committee on Commercial and Industrial Policy after the War, it is pointed out that " it would seem well worth while to take into careful consideration the possibility of so developing the Indian cinchona and quinine production as to make the Empire independent of outside sources of supply of cinchona and of quinine."

The position became, in some respects, less satisfactory in recent years before the war, owing to the arrangement of an understanding between the planters of cinchona in Java and the principal quinine manufacturers in Europe and America, having for its object the raising of the price of bark to what planters in Java considered a remunerative level. Up to 1913 cinchona bark was over-produced, and the prices obtained for bark were so low that cinchona was being replaced on a considerable scale in Java by tea and other crops. In July 1913 the planters made an arrangement with the quinine manufacturers whereby the price of bark was to depend to some extent on the price obtained for quinine. Details of this agreement have not been published, but, according to information which then appeared in the technical press, the European and American

quinine manufacturers undertook to buy each year, from the combined producers of bark in Java, bark equivalent to 515,000 kilograms of quinine sulphate, at the rate of 5 cents (*1d.*) per unit per cent. of quinine sulphate for each half-kilogram of bark, so long as the price of quinine sulphate did not rise beyond that ruling at the time the contract was signed. Any rise in the price of quinine beyond this figure was to be divided equally between the producers of bark and the quinine manufacturers. A central office, known as the Kina Bureau, was constituted in Amsterdam to supervise the working of this arrangement and organise the details of marketing, etc. It is understood that all quinine manufacturers were concerned in this arrangement, including the factories in Java, Holland, Germany, France, the United Kingdom, and the United States, and also that all cinchona producers in Java, including the Netherland East Indian Government plantations, were parties to it. At that time a certain amount of bark was purchased each year from Java for Government quinine factories in India, and it is understood that by the terms of the agreement a satisfactory supply of Java cinchona bark was guaranteed to India for this purpose.

The working of this agreement naturally presented great difficulties during the war, but in the short time that elapsed between its signature and the outbreak of the war it is said to have had the effect of raising the price of bark and stopping the reduction of output in Java, which was proceeding in 1913. In spite of these difficulties the agreement seems to have been sufficiently satisfactory to all parties to ensure its renewal in some form when the original contract lapsed in July 1918.

Regarding the second contract, which is to last until July 1923, little information has become public. According to statements which have appeared in the technical press, the only quinine manufacturers now concerned are those in Holland and Java, who have contracted to take the same amount of bark, the equivalent of 515,000 kilograms of quinine sulphate, as was allocated to the quinine manufacturers of the whole world in 1913. The basis of the new contract is stated to be the price of quinine

sulphate. When this does not exceed 20 florins per kilogram the planters are to receive three-fifths, and the quinine makers the rest. Any advance on this price is to be divided equally between the two parties. The Kina Bureau, under the new contract, is apparently to fix the price of quinine and to exercise more control over the industry. If these statements may be accepted as correct the Dutch and Java factories are placed in a very strong position in regard to quinine manufacture.

In this connection it may be mentioned that the Java factory at Bandoeng was reported in 1916 to be working about one-fifth of the total output of bark in Java. The exports of quinine sulphate from Java have risen from 2,556,887 oz., valued at £120,845, in 1913, to 4,572,128 oz., valued at £546,621, in 1917. The Bandoeng factory has for many years been extraordinarily successful, and during the war it has been extended owing to the necessity of shipping quinine instead of bark from Java, and to the scarcity of tonnage. It is stated that one of the Dutch quinine factories has made an agreement recently with the Bandoeng factory for the manufacture of part of its quinine output in Java.

Such information as has become public regarding the terms of the new contract does not deal with the position of the quinine factories in Germany, France, the United States and the United Kingdom, and it is not known whether these factories will be able to secure supplies of bark by negotiation with the Kina Bureau. The position of the single British quinine factory has been partially safeguarded by an arrangement, made, it is understood, at the suggestion of His Majesty's Government, whereby this factory is to be supplied with bark during the next ten years by certain British companies owning cinchona plantations in Java, who are not now parties to the cinchona contract, and whose output is estimated at about 9 per cent. of the total Java output. It is also understood that certain Dutch cinchona-producing companies in Java are standing out of the contract, and some of them are said to have arranged for the disposal of their bark to Japan, where the manufacture of quinine has been undertaken since the war began. It is clear, from the

foregoing, that the supplies of cinchona bark to countries other than Holland are becoming uncertain, and it is understood that quinine manufacturers in the Allied countries and the United States have formed an Association to watch the position and to take such steps as may be possible to safeguard their interests. It may also be mentioned that a special mission from America has recently investigated the possibility of securing sufficient cinchona bark or quinine from Colombia to meet the needs of the United States. Arrangements are also said to have been made for the manufacture of quinine from locally grown bark in Brazil and Peru, and experimental plantation of cinchona is stated to have been undertaken in Japan and the Philippines.

Cinchona has been introduced elsewhere in the tropics, but there is at present no prospect of commercial production. The bark grown in St. Helena, the Cameroons, and Tanganyika Territory examined at the Imperial Institute, has proved to be of good quality, the best being a hybrid bark from the Tanganyika Territory, which contained 8·4 per cent. of quinine. It is doubtful, however, whether commercial production will take place in these countries, at any rate, in the near future (see pp. 31–40).

It seems likely that cinchona could be grown successfully on the hills of British Malaya. An area of twenty acres was planted with *C. succirubra* and *C. Ledgeriana* on Gunong Angsi, Negri Sembilan, at an elevation of 1,500 feet, in March 1914, and three years later the plants were stated to be making excellent growth. The Federated Malay States Government are considering the advisability of establishing quinine plantations, and areas of land near Kuala Pilah Pass and round Ginting Simpah have been reserved pending the selection of the actual area required. It has been suggested that, as the local demand for quinine would not justify the erection of a factory in Malaya, it might be possible to have the bark produced in the Federated Malay States worked up in the Indian factories.

The dependence of France and the United States, and also Germany, on Java, either directly or through Holland, for supplies of cinchona bark is indicated by the import

figures for these countries given in Tables VIII, X and XII appended to this Report. The extent of the transit trade in cinchona bark in Holland is shown by the import and export figures given in Table V. The United States is also dependent to some extent on Holland and the Dutch East Indies for its supplies of quinine, although large quantities were imported from Germany before the war (see Table XI). France, up to the year 1916, and Germany up to 1913, on the other hand, exported more quinine than they imported (see Tables IX and XIII).

A memorandum prepared at the Imperial Institute on the Indian Trade in Cinchona Bark has been published in the *Bulletin of the Imperial Institute* (No. 2 of 1918).

## The Demand for Quinine in the British Empire

The importance of cinchona bark depends almost entirely on the fact that it is the only available raw material for the manufacture of quinine. The world's trade in cinchona bark is, therefore, chiefly concerned with the barks of *Cinchona Ledgeriana* and certain cinchona hybrids, which are rich in quinine, and contain comparatively small quantities of the other cinchona alkaloids, such as quinidine, cinchonine, and cinchonidine. There is a certain demand for the barks of other species, such as *Cinchona succirubra*, *Cinchona officinalis* and *Cinchona robusta*, which are usually exported as quills and are normally used for the manufacture of galenical preparations, and are therefore known as "druggists' bark." The barks rich in quinine, and used in quinine factories, usually come over in the form of chips, and are known as "factory barks." India and Ceylon export chiefly druggists' bark, though a considerable amount of factory bark is grown in India for use in the Government quinine factories in Madras and Bengal. Quinine is used for many purposes in medicine, but the principal demand for it is as a prophylactic against, and a remedy for, malaria, and it is on this account that the British Empire, with its great stretches of tropical territory containing many regions in which malaria is common, is specially concerned in the safeguarding of the sources of supply of cinchona

bark and quinine. It is now known that malaria is spread through the agency of certain kinds of mosquitoes which breed in swamps in tropical and sub-tropical regions. Much has been done to reduce the incidence of malaria in such regions by sanitary measures, such as the clearing and draining of mosquito-infested swamps, but there is no prospect at present that such measures are likely to be undertaken on a large enough scale in the near future seriously to reduce the demand for quinine. On the contrary, it seems likely that the organisation of campaigns against malaria in tropical countries is likely to increase and to lead to an increased use of quinine.

It is not easy to estimate the total annual consumption of quinine in the British Empire, since the amounts imported into the various Dominions and Colonies are, as a rule, too small to be shown in the trade returns. The only countries in the Empire which give detailed statistics of the trade in cinchona bark and quinine and its salts are the United Kingdom and India, and figures for these countries are given in Tables Nos. I–IV appended to this Report.

From a consideration of the amount of cinchona bark retained in the United Kingdom, and the quantities of quinine imported and exported, it appears that the net consumption of quinine in this country during the five years 1909–13 averaged 2,540,000 oz. per annum. During the three war years 1915–17 the annual consumption exceeded 3,000,000 oz. These estimates are slightly in excess of the actual figures, as no deduction is made for the " druggists' bark " used in this country, and the calculation has been made on the assumption that all the bark retained is used for the manufacture of quinine.

In the case of India it is difficult to ascertain exactly the consumption of quinine, as for some years prior to 1915–16 cinchona bark and quinine and its salts are not given separately in the trade returns. Assuming that they were imported in the same proportion as in 1915–16 and subsequent years, the net imports of quinine and its salts, including Government Stores, average 1,920,000 oz. annually in the five years 1909–10 to 1913–14.

The total output of quinine in India in these years averaged 1,075,000 oz., of which none was exported, making the average consumption 2,995,000 oz. In the years 1915–16 to 1919–20 the net imports averaged 1,130,000 oz. annually and the output 1,110,000 oz., making the total consumption 2,240,000 oz.

Assuming that the rest of the Empire consumes 2,000,000 oz. the total demand for quinine in the British Empire is probably in the neighbourhood of 8,000,000 oz. Expressed on the basis of Java cinchona bark yielding 6 per cent. of quinine sulphate, this corresponds to 8⅓ million lb. of cinchona bark, or about 36 per cent. of the Java output, and 33 per cent. of the world's output. Towards these requirements the Empire's only contribution of bark is about 1,500,000 lb., i.e. the quantity of Indian-grown bark used in the Government factories in Madras and Bengal; for this purpose the "druggists' bark" exported from India, Ceylon and elsewhere is omitted, as it is not generally used for producing quinine. In addition to this British output there is available for quinine manufacture in the Empire the output of cinchona bark from the plantations owned by British companies in Java. According to the evidence supplied to the Special Committee this amounts to perhaps 1,800,000 lb. per annum, or 9 per cent. of the total output of cinchona bark in Java.

The position may be summarised thus. Ample supplies of quinine are required by the British Empire, more especially in the tropical Possessions, for the prevention and treatment of malaria. At present these requirements amount to about 8,000,000 oz. per annum, corresponding to about 8⅓ million lb. of cinchona bark of average Java quality. In spite of sanitary measures for the clearance of mosquito-infested swamps in British tropical countries, and the application of new remedies for malaria, it seems clear that these requirements are likely to increase rather than to diminish in the future.

Towards the present requirements India contributes annually about 1,200,000 oz. of quinine made from Indian-grown bark, and the United Kingdom supplies 1,800,000 oz., which will during the next ten years be made from

Java bark under partial British control as described on p. 5.

This leaves no less than 5,000,000 oz. of quinine, which must be obtained annually from foreign countries. The foreign countries which will form the source of supply of this quinine in future will be chiefly Holland and Java, as a result of the pooling arrangements described on pp. 3–5, unless special steps are taken to produce all the cinchona bark and quinine required by the British Empire within the Empire itself. This view is confirmed by the fact that the total imports of quinine from Java and Holland to the United Kingdom increased from 1,400,370 oz. in 1913 to 5,732,745 oz. in 1919.

## Possibilities of Increased Cinchona Bark Production in India

Table No. I appended gives a summary of the development of cinchona bark and quinine production, and of imports, exports and re-exports of cinchona bark and quinine in India during the twenty-five years ending 1919–20. The figures for each year from 1911–12 to 1919–20 are given in Table No. II.

It is clear from these tables that the demand for quinine in India has steadily increased, and that, although considerable enterprise has been shown by the Cinchona Departments of Madras and Bengal in increasing the output of factory bark from their plantations and extending the production of quinine in their factories, especially since the war began, large quantities of quinine have still to be imported to meet the demand. This position has been receiving attention in India, and the Committee have read with great interest the Report on the Extension of Cinchona Cultivation in India by Lieut.-Colonel A. T. Gage, I.M.S. Colonel Gage explains that large extension of cinchona cultivation in the areas in India in which this industry is now carried on is not possible, and, after a careful survey of other possible areas, recommends sites in Northern Tavoy, Burma, both for the planting of cinchona and the manufacture of quinine.

The question of the location of new cinchona plantations in India, and the equally important one of extending the manufacture of quinine in India, are outside the scope of this Committee's enquiry; but, in view of the facts cited already in this Report, the Committee desire to place on record their satisfaction that these important subjects are now being considered by the Government of India.

## General Conclusions and Recommendations

The question which the Special Committee have mainly to consider is that of the means to be taken to increase the demand for Indian raw materials, in this case cinchona bark, within the Empire. During the five years ending 1916–17 the Indian exports of cinchona bark averaged over 600,000 lb. per annum, all of which was sent to the United Kingdom; in the three following years the exports fell to 40,000, 27,000 and 198,000 lb. respectively. These exports chiefly consist of druggists' bark (see p. 7), which, so far as the Committee can ascertain, is of satisfactory quality, and is, in fact, much sought after in the small market that exists for this type of bark, so that no action on this subject is required. The main demand is, however, for "factory bark," i.e. cinchona bark for the manufacture of quinine, and India exports little or no bark of this quality. Though India produces cinchona bark of the factory type, especially in the Government plantations in Madras and Bengal, this is all used in the two Government quinine factories, and in practice it may be said that none is available for export. The Committee have ascertained that there is a large demand within the Empire for cinchona bark of the ledger and hybrid types, suitable for the manufacture of quinine. In view of the importance of this matter, as shown by the facts quoted in the earlier part of this report, the Committee have carefully considered the question of how this demand can be met. They are of opinion that a serious effort should be made to produce in India sufficient bark of this type to meet a much larger proportion of the Empire's requirements, which they estimate at 8,000,000

lb. annually, and of which nearly 7,000,000 lb. is at present derived from foreign sources, chiefly from Java.

Apart from the technical difficulties of producing in India, as cheaply and efficiently as in Java, cinchona bark rich in quinine, and which can no doubt to a large extent be overcome in view of the experience already gained in India in the production of barks of this type, certain commercial difficulties require attention. As already pointed out, there was for some years prior to 1913 over-production of cinchona bark, which led to low prices being obtained by the planters, and which, but for the arrangement made in that year between quinine makers and Java planters, might have led to a considerable reduction in the Java output of bark. The possibility of over-production and its attendant troubles are serious obstacles to the extension of cinchona planting in India by private enterprise, and if any large extension of cinchona plantation is to be undertaken in India, special steps may have to be taken to overcome such obstacles.

The Committee do not consider it necessary for attempts to be made to meet the entire demand of the Empire from India, but even if the considerable extension, which seems desirable in India, is to take place, the effect on the market will require consideration.

One method of dealing with this matter would be by joint action between the Indian and Imperial Governments, the former undertaking to produce the bark, and both Governments making such arrangements as may be necessary to ensure the whole of the output being utilised within the Empire for quinine. The Indian Government might take a quantity sufficient to keep employed the existing and any additional quinine factories in India, the remainder going to the Imperial Government towards meeting the manufacturing requirements of the United Kingdom both for home consumption and for export of quinine salts made in this country. This would mean the extension of quinine manufacture in the United Kingdom, where there is at present only one quinine factory which actually extracts quinine from bark. Some years ago there was a second factory, which is stated to have been so successful, especially in catering for export

trade in quinine, that it was acquired by German quinine-makers, and afterwards closed. At present it would be difficult, if not impossible, to extend the manufacture of quinine in the United Kingdom, since adequate supplies of suitable bark cannot be obtained otherwise than through the Kina Bureau, which, since it is controlled by the quinine interests of Holland and Java, could hardly be expected to encourage such an enterprise.

The Committee are of opinion that there would be no difficulty in extending facilities for quinine manufacture by private enterprise in the United Kingdom if supplies of bark could be secured. There remains for consideration the question of finance. It appears to be clear that the method of fixing prices for bark adopted by the Kina Bureau is satisfactory both to planters and quinine manufacturers, and there appears to be no reason why India should not produce bark equal in quality and as low in price as the Java product. Further, it is clear that any fall in price would, in view of past experience, lead to abandonment of cinchona by the less remunerative plantations in Java. There seems to be no reason, therefore, why the Government of India should not secure for its bark, or guarantee to planters in India, whatever price is fixed by the Kina Bureau in Amsterdam for Java bark, and it is understood that this basis has been adopted in the arrangement previously referred to between British cinchona planting companies in Java and the British quinine factory. On the manufacturing side there would seem to be no difficulty. The Government quinine factories in India appear to have been financially successful. Most of the other quinine factories in the world are privately owned and precise information as to their financial position is not available, except in one case, viz. the Bandoeng factory in Java, and, from the information which appears from time to time in the technical press in relation to this factory, there can be no doubt that quinine manufacture has been and is a highly profitable business.

Should the extension of cinchona planting in India be decided on, at least one other quinine factory will be required, either in India or in England. The Indian

plantations would not be in a position to furnish regular supplies of bark for several years, and, if the new factory is to be started at once, arrangements would have to be made for it to be supplied in the meantime with bark from Java. If such arrangements cannot be made, the provision of the factory would have to be deferred until the Indian plantations are in bearing. The possibility of the Federated Malay States being in a position to supply bark to the Indian factories in the future should also be borne in mind.

So far the question of the supply of cinchona bark and quinine under peace conditions only has been dealt with, and the Committee consider that the Empire should not have to depend so largely on a single foreign country for this important product.

When the possibility of war is taken into account the position becomes more serious, and renders it all the more desirable that we should be less dependent on a foreign country for our principal supplies of cinchona bark and quinine. It is true that by the agreement of September 3, 1918, the associated countries (England, France, Italy and America) were able to secure practically the whole year's production of Java quinine; but circumstances may not be so favourable to this country for such an arrangement in the future.

It has been suggested that the position might be met by the storage of adequate supplies of bark and quinine. It would, however, appear that the extended cultivation of cinchona and the development of quinine manufacture within the Empire provides a better and more economical solution.

There would in the present circumstances be great difficulty in securing an adequate supply either of cinchona bark or quinine for storage, and when it is remembered that the Empire uses the equivalent of over 8,000,000 lb. of cinchona bark per annum, it will be clear that adequate supplies could not be withdrawn for storage without serious dislocation of the market. Further, the storage policy would involve unremunerative locking up of capital, which could be more usefully employed in encouraging cinchona cultivation and quinine manufacture, two industries

which on many grounds it is desirable shoud be extended within the Empire.

WYNDHAM R. DUNSTAN (*Chairman*).
H. ADAMSON.
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J. R. DUNLOP SMITH.
T. A. HENRY (*Secretary*).

*December*, 1920.

# II

## APPENDIX—STATISTICAL TABLES

### TABLE I. SUMMARY OF PRODUCTION AND TRADE IN CINCHONA BARK AND QUININE IN INDIA

I. CINCHONA BARK

| Average for five years ending | Production in Government Plantations. | | | Imports. | Exports. |
|---|---|---|---|---|---|
| | Madras. | Bengal. | Total. | | |
| | *lb.* | *lb.* | *lb.* | *lb.* | *lb.* |
| 1899–1900 | 157,300 | 571,975 | 729,275 | — | 1,793,992 |
| 1904–5 | 156,634 | 253,014 | 409,648 | — | 1,707,307 |
| 1909–10 | 253,913 | 405,467 | 650,380 | [2] | 517,977 |
| 1914–15 | 374,689 | 556,503 | 931,192 | [2] | 537,737 |
| 1919–20 | 128,552[1] | 604,656 | 733,208 | 1,706[3] | 313,141 |

[1] *Average of* 1915–16, 1917–18, 1918–19, *and* 1919–20 *only; figures are not available for* 1916–17, *in which year only "a minimum quantity" was harvested.*

[2] *The Reports of the Madras Cinchona Department show that in the years* 1906–7 *to* 1913–14 *a quantity of bark was purchased in Amsterdam for use in the Government factory, but no imports of bark are shown separately in the official trade returns, either under the heading "Government Stores" or "General Imports." The average annual amount purchased in Amsterdam in the four years* 1906–7 *to* 1909–10 *was* 189,918 *lb., with a maximum of* 436,863 *lb. in the last-named year; the average for the next four years was* 426,647 *lb., with a maximum of* 650,431 *lb. in* 1912–13.

[3] *Exclusive of Government Stores* (*see foot-note to Table on next page*).

II. QUININE

| Average for five years ending | Production in Government Factories. | | | Imports.[1] | Exports. | Re-exports. |
|---|---|---|---|---|---|---|
| | Madras. | Bengal. | Total. | | | |
| | *oz.* | *oz.* | *oz.* | *oz.* | *oz.* | *oz.* |
| 1899–1900 | 132,544 | 156,672 | 289,216 | 779,360 | nil | 12,365 |
| 1904–5 | 190,864 | 174,928 | 263,792 | 923,888 | nil | 2,528 |
| 1909–10 | 354,000 | 381,184 | 735,184 | 1,351,688 | nil | 6,880 |
| 1914–15 | 445,600 | 673,344 | 1,118,944 | 1,806,128[2] | nil | 17,632 |
| 1919–20 | 578,477 | 557,237 | 1,114,702 | 1,169,133 | nil | 32,080[3] |

[1] *Exclusive of Government Stores, which averaged* 720 *oz. in the period ending* 1899–1900, 824 *oz. in that ending* 1904–5, 30,304 *oz. in that ending* 1909–10, 189,974 *oz. in that ending* 1914–15, *and* 281,640 *oz. in the four years ending* 1918–19.

[2] *Includes a small amount of cinchona bark.*

[3] *Average of* 1915–16 *to* 1918–19; *figures for* 1919–20 *not available.*

## TABLE II. PRODUCTION AND TRADE IN CINCHONA BARK AND QUININE IN INDIA, 1911–12 TO 1919–20

### I. Cinchona Bark

| | Production in Government Plantations. | | | Imports. | Exports. |
|---|---|---|---|---|---|
| | Madras. | Bengal. | Total. | | |
| | *lb.* | *lb.* | *lb.* | *lb.* | *lb.* |
| 1911–12 | 402,494 | 299,380 | 701,874 | [1] | 410,032 |
| 1912–13 | 460,965 | 611,338 | 1,072,303 | [1] | 659,285 |
| 1913–14 | 445,737 | 690,524 | 1,136,261 | [1] | 605,102 |
| 1914–15 | 349,451 | 680,375 | 1,029,826 | [1] | 642,087 |
| 1915–16 | 352,165 | 569,337 | 921,592 | 1,543 | 607,807 |
| 1916–17 | [2] | 499,417 | — | 720[3] | 688,543 |
| 1917–18 | 87,037 | 618,703 | 705,740 | 3,903[3] | 40,180 |
| 1918–19 | 44,141 | 822,779 | 866,920 | 797 | 27,498 |
| 1919–20 | 30,867 | 513,043 | 543,910 | 1,408 | 198,506 |

[1] *Included with quinine.*

[2] *Figure not available; "minimum quantity" only collected.*

[3] 564 *lb. of bark were re-exported in* 1916–17, 500 *lb. in* 1917–18, *and* 20 *lb. in* 1918–19.

[4] 40,320 *lb. of bark also imported as Government Stores.*

### II. Quinine

| | Production in Government Factories. | | | Imports.[1] | Exports. | Re-exports. |
|---|---|---|---|---|---|---|
| | Madras. | Bengal. | Total. | | | |
| | *oz.* | *oz.* | *oz.* | *oz.* | *oz.* | *oz.* |
| 1911–12 | 487,824 | 646,064 | 1,133,888 | 2,000,064[2] | nil | 50,464 |
| 1912–13 | 417,120 | 701,948 | 1,118,768 | 1,676,240[2] | nil | 6,976 |
| 1913–14 | 424,256 | 824,992 | 1,249,248 | 1,873,408[2] | nil | 24,672 |
| 1914–15 | 470,252 | 554,400 | 1,025,152 | 1,424,544[2] | nil | 720 |
| 1915–16 | 523,008 | 669,040 | 1,192,048 | 1,525,328 | nil | 57,632 |
| 1916–17 | 840,208 | 334,448 | 1,174,656 | 764,640 | nil | 18,560 |
| 1917–18 | 886,224 | 470,672 | 1,356,896 | 1,946,512 | nil | 33,536 |
| 1918–19 | 371,872[3] | 548,372 | 920,244 | 1,510,768 | nil | 18,592 |
| 1919–20 | 277,088[3] | 763,636 | 1,040,720 | 1,190,416 | nil | [4] |

[1] *Exclusive of Government Stores, which amounted to* 230,848 *oz. in* 1911–12, 645,840 *oz. in* 1912–13, 59,216 *oz. in* 1913–14, 2,816 *oz. in* 1914–15, 6,928 *oz. in* 1915–16, 23,952 *oz. in* 1916–17, 27,264 *oz. in* 1917–18, *and* 1,068,736 *oz. in* 1918–19; *figures for* 1919–20 *not available.*

[2] *Imports of quinine and alkaloids thereof, including cinchona bark.*

[3] *The output in these years was reduced owing to a disastrous fire at the factory during* 1918–19.

[4] *Figures not available.*

## TABLE III. TRADE IN CINCHONA BARK IN THE UNITED KINGDOM, 1913–19

### I. Imports

| | | 1913. | 1914. | 1915. | 1916. | 1917. | 1918. | 1919. |
|---|---|---|---|---|---|---|---|---|
| Total quantity | lb. | 2,925,664 | 3,734,752 | 2,286,592 | 3,039,792 | 3,800,608 | 3,263,680 | 6,645,520 |
| Total value | £ | 58,003 | 75,234 | 55,819 | 128,168 | 227,177 | 227,528 | 337,318 |
| From: | | lb. | lb. | lb. | lb. | lb. | lb. | lb. |
| Netherlands | | 1,110,592 | 258,832 | 81,312 | 1,372,336 | 2,318,624 | 103,712 | 450,352 |
| Java | | 1,168,720 | 2,643,088 | 1,781,248 | 370,160 | 837,872 | 2,556,736 | 5,451,712 |
| Peru | | 23,296 | 12,432 | 17,024 | 208,096 | 108,416 | 34,160 | 244,720 |
| Other foreign countries | | 80,528 | 43,792 | 80,640 | 178,640 | 370,048 | 165,872 | 307,552 |
| Total foreign countries | | 2,383,136 | 2,958,144 | 1,960,224 | 2,129,232 | 3,634,960 | 2,860,480 | 6,454,336 |
| Total British Possessions | | 542,528 | 776,608 | 326,368 | 910,560 | 165,648 | 403,200 | 191,184 |

### II. Re-exports

| | | 1913. | 1914. | 1915. | 1916. | 1917. | 1918. | 1919. |
|---|---|---|---|---|---|---|---|---|
| Total quantity | lb. | 2,085,552 | 1,701,056 | 808,640 | 1,001,200 | 1,754,928 | 3,006,752 | 4,377,744 |
| Total value | £ | 54,846 | 32,008 | 20,638 | 39,397 | 109,343 | 271,665 | 277,114 |
| To: | | lb. | lb. | lb. | lb. | lb. | lb. | lb. |
| India | | 1,545,376 | — | — | — | — | — | — |
| Other British Possessions | | — | — | 4,592 | 23,968 | 16,464 | 9,744 | 23,408 |
| Total British Possessions | | 1,545,376 | — | 4,592 | 23,968 | 16,464 | 9,744 | 23,408 |
| France | | 242,144 | 113,792 | 232,960 | 305,344 | 1,369,424 | 2,576,560 | 3,298,064 |
| United States | | 2,912 | 14,448 | 14,224 | 352,912 | 229,600 | 414,736 | 764,848 |
| Netherlands | | 24,528 | 1,433,936 | 419,552 | 71,680 | — | — | 448 |
| Germany | | 203,280 | 113,120 | — | — | — | — | — |
| Other foreign countries | | 67,312 | 25,760 | 137,312 | 187,376 | 139,440 | 5,712 | 290,976 |
| Total foreign countries | | 540,176 | 1,701,056 | 804,048 | 977,312 | 1,738,464 | 2,997,008 | 4,354,336 |

### III. Net Imports

*(Total Imports less Re-exports)*

| | 1913. | 1914. | 1915. | 1916. | 1917. | 1918. | 1919. |
|---|---|---|---|---|---|---|---|
| | lb. | lb. | lb. | lb. | lb. | lb. | lb. |
| | 840,112 | 2,033,696 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |

TABLE IV. TRADE IN QUININE AND QUININE SALTS IN THE UNITED KINGDOM, 1913–19

I. IMPORTS

| | 1913. | 1914. | 1915. | 1916. | 1917. | 1918. | 1919. |
|---|---|---|---|---|---|---|---|
| Total quantity . . . . . oz. | 2,422,944 | 1,868,515 | 4,581,646 | 3,727,022 | 5,019,967 | 2,380,149 | 5,764,943 |
| Total value . . . . . £ | 102,102 | 102,410 | 320,992 | 519,197 | 554,137 | 306,099 | 595,222 |
| From: | oz. | oz. | oz. | oz. | oz. | oz. | oz. |
| France . . . . . | — | 2,784 | 47,076 | 29,441 | 4,848 | 1,168 | 6,938 |
| United States . . . . . | 110,000 | 76,800 | 860,172 | 26,104 | — | 3,584 | — |
| Netherlands . . . . . | 1,009,970 | 1,087,772 | 3,267,913 | 3,561,683 | 4,114,562 | 772,701 | 236,040 |
| Java . . . . . | 390,400 | 246,650 | 264,200 | — | 894,701 | 1,582,808 | 5,496,705 |
| Germany . . . . . | 908,986 | 427 423 | — | — | — | — | — |
| Other foreign countries . . . | 3,588 | 27,006 | 119,933 | 86,190 | 5,856 | 4,672 | 21,540 |
| Total from foreign countries . . | 2,422,944 | 1,868,435 | 4,559,294 | 3,703,418 | 5,019,967 | 2,364,933 | 5,761,223 |
| Total from British Possessions . . | — | 80 | 22,352 | 23,604 | — | 15,216 | 3,720 |

## TABLE IV. TRADE IN QUININE AND QUININE SALTS IN THE UNITED KINGDOM, 1913–19 (*cont.*)

### II. EXPORTS

*(Home Manufacture)*

| | | 1913. | 1914. | 1915. | 1916. | 1917. | 1918. | 1919. |
|---|---|---|---|---|---|---|---|---|
| Total quantity | *oz.* | 1,374,328 | 1,477,703 | 2,412,969 | 1,659,030 | 736,525 | 406,207 | 1,722,191 |
| Total value | £ | 72,642 | 91,415 | 221,218 | 225,763 | 118,516 | 68,267 | 287,499 |
| To: | | *oz.* | *oz.* | *oz.* | *oz.* | *oz.* | *oz.* | *oz.* |
| British India | | 696,015 | 746,091 | 598,786 | 480,180 | 169,701 | 70,472 | 332,241 |
| Ceylon and Dependencies | | 90,271 | 116,666 | 122,210 | 116,659 | 125,498 | 48,606 | 48,824 |
| Australia | | 58,750 | 63,405 | 36,076 | 46,683 | 11,925 | 5,942 | 9,209 |
| Union of South Africa | | 23,830 | 20,943 | 48,065 | 27,751 | 40,261 | 5,528 | 16,116 |
| Other British Possessions | | 177,250 | 174,082 | 232,426 | 194,220 | 105,639 | 127,739 | 271,670 |
| Total to British Possessions | | 1,046,116 | 1,121,269 | 1,037,563 | 865,493 | 453,024 | 258,287 | 678,060 |
| Russia | | 19,447 | 94,666 | 456,379 | 208,244 | 54,804 | — | 10,167 |
| France | | 640 | 295 | 776 | 35,359 | 45,415 | 100 | 10,226 |
| Portugal | | 3,344 | 15,078 | 87,200 | 3,869 | 4,578 | 1,397 | 10,340 |
| Italy | | 4,727 | 3,459 | 574,380 | 324,157 | 2,900 | 54,551 | 621,718 |
| United States | | 5,326 | 2,999 | 35,488 | 26,426 | 4,359 | 215 | 97,406 |
| Brazil | | 13,698 | 9,502 | 88,249 | 68,531 | 109,131 | 39,582 | 106,727 |
| China (excluding Hong Kong, Macao) | | 71,564 | 52,960 | 50,372 | 76,032 | 21,001 | 6,919 | 20,094 |
| Turkey | | 99,062 | 89,067 | 1,914 | 250 | — | 1,212 | 22,080 |
| Other foreign countries | | 110,504 | 88,408 | 80,648 | 50,678 | 41,313 | 43,944 | 145,373 |
| Total to foreign countries | | 328,212 | 356,434 | 1,375,406 | 793,537 | 283,501 | 147,920 | 1,044,131 |

## TABLE IV. TRADE IN QUININE AND QUININE SALTS IN THE UNITED KINGDOM, 1913–19 (*cont.*)

### III. Re-exports

*(Foreign and Colonial Merchandise)*

| | 1913. | 1914. | 1915. | 1916. | 1917. | 1918. | 1919. |
|---|---|---|---|---|---|---|---|
| Total quantity . . . . . oz. | 305,591 | 82,865 | 701,055 | 219,805 | 1,403,547 | 1,562,970 | 3,327,331 |
| Total value . . . . . £ | 11,768 | 4,676 | 85,807 | 48,816 | 162,855 | 187,045 | 369,408 |
| To: | oz. | oz. | oz. | oz. | oz. | oz. | oz. |
| British India . . . . . | 216,142 | 23,323 | 13,614 | 1,172 | 2,656 | 190 | — |
| Australia . . . . . | 7,272 | 1,320 | 10,100 | 11,710 | 5,236 | 2,765 | 1,152 |
| Union of South Africa . . . . | — | 6,813 | 7,711 | 2,570 | 44,217 | 3,521 | 5,137 |
| Other British Possessions . . . | 19,989 | 16,864 | 6,860 | 6,613 | 14,532 | 1,891 | 16,680 |
| Total to British Possessions . . | 243,403 | 48,320 | 38,285 | 22,065 | 66,841 | 8,367 | 22,969 |
| Russia . . . . . | — | 12,320 | 104,000 | 41,174 | — | — | 8,174 |
| France . . . . . | — | — | — | 3,000 | 211,112 | 6,976 | 1,401,184 |
| Italy . . . . . | — | — | 176,740 | 20,008 | 1,111,937 | 1,447,792 | 1,710,134 |
| United States . . . . . | — | — | 335,672 | 128,684 | 1,000 | 50,000 | 118,900 |
| Other foreign countries . . . | 62,188 | 22,225 | 46,358 | 4,874 | 12,657 | 49,835 | 65,970 |
| Total to foreign countries . . . | 62,188 | 34,545 | 662,770 | 197,740 | 1,336,706 | 1,554,603 | 3,304,362 |

## TABLE V. TRADE IN CINCHONA BARK IN THE NETHERLANDS, 1912–17

### I. Imports

| | 1912. | 1913. | 1914. | 1915. | 1916. | 1917. |
|---|---|---|---|---|---|---|
| Total quantity . . . . *lb.* | 20,419,650 | 19,946,354 | 15,300,611 | 12,244,965 | | 4,760,278 |
| From: | *lb.* | *lb.* | *lb.* | *lb.* | *lb.* | *lb.* |
| United Kingdom . . . . . | 16,078 | 32,317 | 1,118,699 | 100,035 | | — |
| Belgium . . . . . | 5,918 | 2,484 | 966 | 8,353 | | — |
| Hamburg . . . . . | 40,390 | — | — | — | | — |
| Prussia . . . . . | — | 2,241 | 177 | 1,862 | Figures | — |
| Java . . . . . | 18,354,943 | 19,909,312 | 14,177,428 | 12,134,715 | not | 4,757,951 |
| China . . . . . | 2,321 | — | — | — | available. | — |
| Colombia, Ecuador and Venezuela . . | — | — | 3,288 | — | | — |
| Curaçoa . . . . . | — | — | 53 | — | | 2,327 |
| Other countries . . . . . | — | — | — | — | | — |

### II. Exports

| | 1912. | 1913. | 1914. | 1915. | 1916. | 1917. |
|---|---|---|---|---|---|---|
| Total quantity . . . . *lb.* | 14,194,632 | 13,573,823 | 13,869,996 | 10,275,338 | | 8,843,256 |
| To: | *lb.* | *lb.* | *lb.* | *lb.* | *lb.* | *lb.* |
| United Kingdom . . . . . | 2,127,439 | 2,328,643 | 1,609,987 | 1,419,186 | | 1,948,838 |
| Egypt . . . . . | 5,577 | 9,819 | 3,753 | 2,850 | | — |
| France . . . . . | 80,874 | 542,728 | 221,477 | 1,724,211 | | 969,370 |
| Belgium . . . . . | 905,088 | 298,503 | 84,543 | 2,076 | | 3,817 |
| Denmark . . . . . | 27,028 | 27,204 | 18,723 | 23,852 | | — |
| Norway . . . . . | 3,013 | 2,506 | 8,122 | 10,927 | | — |
| Sweden . . . . . | 1,316 | 7,619 | 26,391 | 12,424 | | — |
| Russia . . . . . | 11,095 | 7,496 | 5,457 | — | Figures | — |
| Spain . . . . . | 10,649 | 12,235 | 8,624 | 46,275 | not | — |
| Italy . . . . . | 172,359 | 144,697 | 101,659 | 175,480 | available. | — |
| Bremen . . . . . | 2,102,843 | 2,642,838 | 2,427,497 | — | } | Germany. |
| Hamburg . . . . . | 156,698 | 183,644 | 91,347 | — | } | 5,093,272 |
| Prussia . . . . . | 5,172,021 | 4,530,904 | 5,364,567 | 2,620,975 | } | |
| Austria-Hungary . . . . . | 3,669 | 4,873 | 2,244 | — | | 6,008 |
| Turkey . . . . . | 30,506 | 21,302 | 10,835 | — | | — |
| United States . . . . . | 3,466,929 | 2,794,129 | 3,864,998 | 4,191,197 | | 679,143 |
| Java . . . . . | — | 10,222 | — | — | | 62 |
| Japan . . . . . | — | 4,461 | 9,772 | 45,885 | | — |
| Other countries . . . . . | — | — | — | — | | 142,746 |

## TABLE VI. TRADE IN CINCHONA BARK IN THE NETHERLAND EAST INDIES, 1911–17

### I. Exports

| | | 1911. | 1912. | 1913. | 1914. | 1915. | 1916. | 1917. |
|---|---|---|---|---|---|---|---|---|
| Total quantity | *lb.* | 13,380,788 | 14,489,772 | 17,752,327 | 13,618,527 | 11,655,699 | 18,201,676 | 5,929,482 |
| Total value | £ | 202,371 | 219,144 | 362,457 | 334,696 | 295,270 | 461,098 | 229,094 |
| To: | | *lb.* | *lb.* | *lb.* | *lb.* | *lb.* | *lb.* | *lb.* |
| Great Britain | | 338,957 | 503,868 | 576,926 | 1,110,393 | — | — | 1,980,724 |
| English Channel (for order) | | 7,460 | — | — | 40,741 | — | — | — |
| Holland | | 11,660,946 | 13,354,602 | 16,987,475 | 11,811,709 | 11,648,874 | 18,127,419 | 2,098,063 |
| Holland (for order) | | 829,345 | 503,669 | 108,091 | 655,684 | — | — | — |
| Belgium | | — | — | 79,835 | — | — | — | — |
| United States | | 44,080 | 24,629 | — | — | — | 119 | 1,688,135 |
| China | | — | 88,069 | — | — | — | — | — |
| Japan | | — | — | — | — | 6,825 | 74,138 | 64,341 |
| Other countries | | — | 14,935 | — | — | — | — | 98,219 |

*Note.*—The values are converted from Dutch currency at the rate of 12 fl. = £1.

## TABLE VII. TRADE IN QUININE IN THE NETHERLANDS EAST INDIES, 1911–17.

### I. Exports

| | | 1911. | 1912. | 1913. | 1914. | 1915. | 1916. | 1917. |
|---|---|---|---|---|---|---|---|---|
| Total quantity | *oz.* | 3,542,586 | 2,627,520 | 2,556,887 | 2,185,098 | 2,922,292 | 4,061,531 | 4,572,128 |
| Total value | £ | 83,716 | 62,092 | 120,845 | 103,273 | 227,890 | 316,730 | 546,621 |
| To: | | *oz.* | *oz.* | *oz.* | *oz.* | *oz.* | *oz.* | *oz.* |
| Great Britain | | 461,429 | 197,514 | — | 161,333 | 224,596 | — | 817,238 |
| English Channel (for order) | | 1,032,459 | — | — | — | — | — | — |
| Holland | | 631,085 | 739,239 | 1,320,637 | 337,759 | 734,619 | 1,109,094 | 117,463 |
| Holland (for order) | | — | — | — | 90,029 | 298,192 | — | — |
| Italy | | 137,636 | 646,213 | 542,996 | 595,080 | — | 229,216 | — |
| Russia | | — | — | — | — | 64,992 | — | — |
| Vladivostock | | — | — | — | — | 123,424 | 253,901 | — |
| Germany | | 5,289 | — | — | — | — | — | — |
| United States | | 784,625 | 465,449 | 91,017 | 170,078 | — | 100,009 | 928,752 |
| Philippines | | — | — | — | — | 33,712 | 291,034 | 37,734 |
| Egypt | | — | — | — | — | 45,244 | 370,166 | 189,939 |
| Port Said (for order) | | 56,810 | — | — | — | — | 243,709 | — |
| British India | | 58,679 | 38,332 | 163,302 | 214,899 | 367,749 | 206,612 | 431,517 |
| Singapore | | 133,298 | 199,735 | 170,289 | 186,969 | 88,160 | 379,405 | 227,251 |
| China | | 987 | — | — | 23,592 | 532,310 | 333,456 | 538,947 |
| Japan | | 208,128 | 261,906 | 169,197 | 294,172 | 415,622 | 505,227 | 876,903 |
| Australia | | — | — | — | 42,987 | 18,514 | 88,231 | 111,514 |
| Other countries | | 32,161 | 79,132 | 79,449 | 68,200 | 35,138 | 41,471 | 298,870[1] |

[1] *Including* 82,966 *oz. to Greece,* 73,251 *to South Africa and* 88,634 *oz. to Hong Kong.*

*Note.*—The values are converted from Dutch currency at the rate of 12 fl. = £1.

## TABLE VIII. TRADE IN CINCHONA BARK IN FRANCE, 1913–16 (COMMERCE SPÉCIA

### I. IMPORTS

| | | 1913. | 1914. | 1915. | 1916. | 1917. | 1918. | 1919. |
|---|---|---|---|---|---|---|---|---|
| Total quantity | *lb.* | 2,059,638 | 1,629,197 | 1,678,346 | 2,231,991 | 2,260,202 | 2,232,612 | 2,172,854 |
| Total value | £ | 89,712 | 70,962 | 98,995 | 172,159 | 225,610 | 266,640 | 259,400 |
| From: | | *lb.* | *lb.* | *lb.* | *lb.* | *lb.* | *lb.* | *lb.* |
| United Kingdom | | 247,509 | 210,482 | 186,458 | 559,596 | 1,722,426 | | |
| Netherlands | | 434,408 | 344,926 | 1,437,669 | 1,589,304 | 446,971 | | |
| Netherland East Indies | | 1,256,060 | 880,278 | — | — | — | Figures not available. | Figures not available. |
| Germany | | — | 91,466 | — | — | — | | |
| United States | | — | — | — | — | 42,096 | | |
| Colombia | | — | — | — | 43,860 | 22,481 | | |
| Réunion | | — | — | 1,984 | 1,984 | — | | |
| Other countries | | 121,661 | 102,045 | 52,235 | 37,247 | 26,228 | | |

### II. RE-EXPORTS

| | | 1913. | 1914. | 1915. | 1916. | 1917. | 1918. | 1919. |
|---|---|---|---|---|---|---|---|---|
| Total quantity | *lb.* | 20,718 | 11,240 | 23,803 | 115,269 | 29,974 | 11,020 | 46,076 |
| Total value | £ | 902 | 490 | 1,404 | 8,891 | 2,992 | 1,320 | 5,520 |
| To: | | *lb.* | *lb.* | *lb.* | *lb.* | *lb.* | *lb.* | *lb.* |
| United Kingdom | | 882 | — | — | — | — | | |
| Egypt | | — | — | — | 2,424 | — | | |
| Russia | | — | — | — | 12,563 | — | | |
| Switzerland | | — | — | 1,542 | 1,983 | — | | |
| Germany | | 3,085 | — | — | — | — | | |
| Portugal | | — | — | 4,849 | 39,231 | 7,273 | Figures not available. | Figures not available. |
| Spain | | 1,763 | 3,747 | 8,596 | 19,837 | 7,273 | | |
| Italy | | — | 882 | — | 15,208 | 2,204 | | |
| Greece | | — | — | 1,542 | 16,310 | 3,527 | | |
| Turkey | | 4,408 | 1,322 | — | — | — | | |
| Argentina | | 2,204 | 1,102 | 1,542 | 1,983 | 3,086 | | |
| Brazil | | — | — | — | — | 1,763 | | |
| French Colonies and Protectorates | | 1,543 | 2,424 | 3,747 | 1,983 | 2,424 | | |
| Other countries | | 6,832 | 1,763 | 1,983 | 3,747 | 2,424 | | |

*Note.*—The values are converted from French currency at the rate of 25 frs. = £1.

## TABLE IX. TRADE IN QUININE IN FRANCE, 1913–19 (COMMERCE SPÉCIAL)

### I. IMPORTS

| | 1913. | 1914. | 1915. | 1916. | 1917. | 1918. | 1919. |
|---|---|---|---|---|---|---|---|
| Total quantity . . . . oz. | 14,105 | — | 10,579 | 38,790 | 275,059 | 807,765 | 1,100,536 |
| Total value . . . . £ | 712 | — | 864 | 5,005 | 35,490 | 132,840 | 180,960 |
| From: | oz. | oz. | oz. | oz. | oz. | oz. | oz. |
| United Kingdom . . . . | — | — | — | 28,211 | 81,107 | | |
| United States . . . . | — | — | — | — | 186,899 | Figures not available. | Figures not available. |
| Switzerland . . . . | 10,579 | — | — | 3,526 | — | | |
| Germany . . . . | 3,526 | — | — | — | — | | |
| Other countries . . . . | — | — | 10,579 | 7,053 | 7,053 | | |

### II. EXPORTS

| | 1913. | 1914. | 1915. | 1916. | 1917. | 1918. | 1919. |
|---|---|---|---|---|---|---|---|
| Total quantity . . . . oz. | 652,384 | 476,064 | 352,640 | 391,430 | 49,369 | 38,800 | 194,005 |
| Total value . . . . £ | 36,260 | 26,460 | 28,800 | 50,505 | 6,370 | 7,040 | 35,200 |
| To: | oz. | oz. | oz. | oz. | oz. | oz. | oz. |
| United Kingdom . . . . | 52,897 | — | 63,475 | 38,790 | 7,053 | | |
| India . . . . | 42,317 | — | — | — | — | | |
| Egypt . . . . | — | 35,264 | — | — | — | | |
| Russia . . . . | — | — | — | 17,632 | — | | |
| Belgium . . . . | 38,790 | 35,264 | — | — | — | Figures not available. | Figures not available. |
| Spain . . . . | 81,107 | 123,424 | 70,528 | 84,634 | — | | |
| Italy . . . . | — | — | — | 35,264 | — | | |
| Greece . . . . | 42,316 | — | 10,579 | 17,632 | — | | |
| Turkey . . . . | 105,793 | 70,528 | — | — | — | | |
| Brazil . . . . | — | — | 42,319 | 31,738 | — | | |
| Cuba . . . . | — | 28,211 | — | — | — | | |
| Argentina . . . . | — | — | 17,632 | 10,579 | — | | |
| British East Africa . . . . | — | 35,264 | — | — | — | | |
| Algeria . . . . | — | — | 24,685 | 56,422 | 21,158 | | |
| Tunis . . . . | 17,632 | — | 10,579 | 7,053 | — | | |
| Senegal . . . . | 24,685 | — | — | — | 7,053 | | |
| Other French West Africa Colonies . . . . | — | — | — | — | 3,526 | | |
| Madagascar . . . . | 21,158 | 17,632 | — | — | — | | |
| Indo-China . . . . | 24,685 | 14,106 | — | 21,158 | 3,526 | | |
| French Guiana . . . . | — | — | 10,579 | — | — | | |
| Martinique . . . . | — | — | — | — | 7,053 | | |
| Guadeloupe . . . . | 21,158 | — | — | — | — | | |
| Other French Colonies and Protectorates | 21,158 | 21,158 | 14,106 | 28,211 | — | | |

## TABLE X. TRADE IN CINCHONA BARK IN UNITED STATES FOR YEARS ENDING JUNE 30, 1913–18 AND THE CALENDAR YEAR 1919

### I. IMPORTS

| | 1913. | 1914. | 1915. | 1916. | 1917. | 1918. | 1919. |
|---|---|---|---|---|---|---|---|
| Total quantity . . . . lb. | 3,553,239 | 3,648,868 | 3,944,549 | 3,947,320 | 2,531,397 | 3,273,628 | 5,981,293 |
| Total value . . . . £ | 74,477 | 96,752 | 116,897 | 162,007 | 142,903 | 168,911 | 224,114 |
| From: | lb. | lb. | lb. | lb. | lb. | lb. | lb. |
| United Kingdom . . . . | 29,684 | 11,637 | 8,147 | 283,623 | 191,682 | 85,414 | 1,269,008 |
| Germany . . . . . | 9,610 | 18,043 | — | 933 | — | — | — |
| Netherlands . . . . . | 3,493,945 | 3,618,968 | 3,912,242 | 3,657,273 | 2,329,664 | 655,382 | 13,297 |
| South America . . . . . | — | — | 20,426 | 5,491 | 8,940 | 117,382 | 167,415 |
| Dutch East Indies . . . . | 20,000 | — | — | — | 100 | 2,193,561 | 4,527,856 |
| Other countries . . . . . | — | 220 | 3,734 | — | 1,010 | 221,889 | 3,717 |

### II. RE-EXPORTS

| | 1913. | 1914. | 1915. | 1916. | 1917. | 1918. | 1919. |
|---|---|---|---|---|---|---|---|
| Total quantity . . . . lb. | 632 | — | 9,885 | — | 2,076 | 1,979 | 10,278 |
| Total value . . . . £ | 9 | — | 272 | — | 80 | 185 | 897 |

*Note.*—The values are converted from United States currency at the rate of $4.8 = £1.

## TABLE XI. TRADE IN QUININE IN UNITED STATES FOR YEARS ENDING JUNE 30, 1913–18, AND THE CALENDAR YEAR 1919

### I. Imports

| | 1913. | 1914. | 1915. | 1916. | 1917. | 1918. | 1919. |
|---|---|---|---|---|---|---|---|
| Total quantity . . . . oz. | 3,185,984 | 2,879,466 | 1,829,732 | 1,791,738 | 1,264,357 | 1,445,702 | 3,948,945 |
| Total value . . . . £ | 117,275 | 130,026 | 94,239 | 232,928 | 101,068 | 136,863 | 340,090 |
| From: | oz. | oz. | oz. | oz. | oz. | oz. | oz. |
| United Kingdom . . . . | — | 27,606 | 3,230 | 662,710 | 50,113 | 68,095 | 494,763 |
| France . . . . | 17,184 | 3,490 | 4,133 | 4,174 | 138 | 240 | 1,106,968 |
| Germany . . . . | 1,919,616 | 1,764,598 | 916,619 | 58,492 | 578 | — | 70,000 |
| Netherlands . . . . | 936,533 | 1,082,022 | 726,580 | 853,195 | 901,794 | 140,000 | 551,461 |
| Dutch East Indies . . . . | 289,792 | — | 170,000 | 42,500 | 301,430 | 1,165,980 | 1,265,736 |
| Philippine Islands . . . . | — | — | — | 124,968 | 4,928 | 34,256 | 175,934 |
| Other countries . . . . | 2,859 | 1,750 | 9,170 | 45,699 | 5,376 | 37,131 | 284,083 |

### II. Exports

Not recorded in Trade Returns

### III. Re-exports

| | 1913. | 1914. | 1915. | 1916. | 1917. | 1918. | 1919. |
|---|---|---|---|---|---|---|---|
| Total quantity . . . . oz. | 848 | 172 | 59,457 | 19,722 | 9,800 | 2,409 | 11,603 |
| Total value . . . . £ | 35 | 14 | 3,267 | 1,570 | 1,306 | 507 | 957 |

*Note.*—The values are converted from United States currency at the rate of $4.8 = £1.

## TABLE XII. TRADE IN CINCHONA BARK IN GERMANY, 1909–13

### I. Imports

| | | 1909. | 1910. | 1911. | 1912. | 1913. |
|---|---|---|---|---|---|---|
| Total quantity . | *lb.* | 6,173,183 | 7,027,454 | 7,477,730 | 8,260,812 | 7,189,888 |
| Total value . | £ | 145,778 | 122,112 | 128,249 | 141,703 | 123,339 |
| From: | | *lb.* | *lb.* | *lb.* | *lb.* | *lb.* |
| India . . . | | 117,693 | 281,010 | 168,165 | 434,408 | 217,094 |
| Netherlands . . | | 5,811,948 | 6,512,159 | 6,940,396 | 7,368,192 | 6,127,120 |
| Ecuador . . . | | 182,932 | 182,932 | 168,826 | 112,625 | — |
| Peru . . . | | — | 12,563 | 4,628 | 240,456 | — |
| Other countries . . | | 60,610 | 38,790 | 195,715 | 105,131 | 845,674 |

### II. Re-exports

| | | 1909. | 1910. | 1911. | 1912. | 1913. |
|---|---|---|---|---|---|---|
| Total quantity . | *lb.* | 324,208 | 386,802 | 390,328 | 289,605 | 321,343 |
| Total value . | £ | 10,016 | 11,588 | 11,342 | 8,396 | 9,624 |

*Note.*—The values are converted from German currency at the rate of 20 marks = £1.

## TABLE XIII. TRADE IN GERMANY IN QUININE, 1909–13

### I. Imports

| | | 1909. | 1910. | 1911. | 1912. | 1913. |
|---|---|---|---|---|---|---|
| Total quantity . | *oz.* | 377,325 | 599,488 | 624,172 | 878,074 | 440,800 |
| Total value . | £ | 11,047 | 17,529 | 18,265 | 30,589 | 15,368 |
| From: | | *oz.* | *oz.* | *oz.* | *oz.* | *oz.* |
| Netherlands . . | | 141,056 | 511,328 | 454,905 | 729,965 | 222,163 |
| Switzerland . . | | — | — | 3,526 | 77,581 | 123,424 |
| United States . . | | 158,688 | — | — | — | — |
| Dutch East Indies . | | — | 24,685 | 116,371 | 45,843 | — |
| Other countries . . | | 77,581 | 63,475 | 49,370 | 24,685 | 95,213 |

## II. Exports

| | 1909. | 1910. | 1911. | 1912. | 1913. |
|---|---|---|---|---|---|
| Total quantity . *cz.* | 5,899,667 | 6,527,366 | 7,285,542 | 7,179,750 | 7,250,278 |
| Total value . £ | 188,937 | 209,019 | 245,844 | 259,837 | 294,845 |
| From: | *cz.* | *cz.* | *cz.* | *cz.* | *cz.* |
| United Kingdom . | 260,954 | 433,747 | 458,432 | 606,541 | 782,860 |
| India . . | 299,744 | 232,742 | 193,952 | 222,163 | 359,693 |
| Netherlands . | 236,269 | 225,690 | 172,794 | 183,899 | — |
| Italy . . | 874,547 | 881,600 | 1,445,824 | 1,220,134 | 437,273 |
| Greece . . | 119,898 | 201,005 | 172,793 | 109,318 | — |
| Russia . . | 1,086,131 | 1,241,293 | 1,315,347 | 1,315,347 | 1,541,037 |
| Austria-Hungary . | 186,899 | 176,320 | 257,427 | 289,165 | 264,480 |
| Turkey . . | 260,954 | 289,165 | 335,008 | 215,111 | 119,898 |
| United States . | 1,731,462 | 1,928,941 | 1,999,469 | 1,960,678 | — |
| Mexico . . . | — | 102,265 | 70,528 | 74,054 | — |
| Brazil . . . | — | 70,528 | 88,160 | 81,107 | — |
| China . . . | — | 63,475 | 88,160 | 130,477 | — |
| Japan . . . | 250,374 | 169,267 | 165,741 | 31,738 | . . |
| Other countries . . | 592,435 | 511,328 | 521,907 | 737,018 | 3,745,037 |

*Note.*—The values are converted from German currency at the rate of 20 marks = £1.

## III

## REPORT BY THE IMPERIAL INSTITUTE ON THE QUALITY OF CINCHONA BARK GROWN IN ST. HELENA, EAST AFRICA AND THE CAMEROONS

CINCHONA bark produced in St. Helena, East Africa and the Cameroons has been received recently at the Imperial Institute, and the results of its examination are given below, together with an account of the cultivation of cinchona in these countries.

### ST. HELENA

Cinchona was introduced into St. Helena on the advice of Sir J. D. Hooker in 1868, when seeds of *Cinchona succirubra* and *C. officinalis* were sown. By the end of 1869 some 540 plants, mainly of these species, but including a few specimens of *C. Calisaya* and *C. Pahudiana*, had been set out in the partially cleared forest near Newfoundland Cottage on the south face of Actæon's Peak. The locality is at nearly the highest altitude in the island, the Peak rising to a height of 2,700 ft. The soil varies in depth at different points, and is a rich black peat, or vegetable mould resting on a bed of reddish, soft volcanic rock. The plants made good growth, in spite of a prolonged drought just after they had been planted, and the Superintendent of Cinchona Plantations, in 1869, expressed himself as satisfied with the prospects. From 1870, however, the plantation was neglected, and afterwards totally abandoned.

At the present time it is estimated there are from 500 to 800 trees in the plantation. Their average height is about 20 ft., and some of the largest have a bole measuring 27 in. in circumference. In spite of the fact that little, if any, attention has been paid to the trees, they are said to be in a healthy condition on the whole, although some have become covered with moss, etc. The trees reproduce readily from naturally sown seeds, and the

flourishing and healthy condition of the existing trees encourages the hope that their growth and propagation might be advantageously increased by systematic cultivation. It is considered that the present plantation could be greatly extended with small expenditure.

The two samples of cinchona bark from St. Helena, described in the following report, were received at the Imperial Institute for examination in September 1917.

No. 1.—This sample consisted of quills and pieces of bark up to 6 in. in length and of varying thickness. The outer surface of the bark was dark-brown, and the inner surface pale yellowish-brown.

No. 2.—This also consisted of quills and pieces of bark, up to 6 in. in length and of varying thickness. The outer surface of the bark was dark reddish-brown, and the inner surface mahogany-red.

The leaves accompanying the samples, together with specimens of the barks, were submitted to Kew for identification, but it was reported that the leaves could not be matched with any of the specimens there; they did not appear to be fully developed, and may have been cut from young plants. A comparison of the barks with samples of cinchona from St. Helena in the Kew Museum suggested that No. 1 may be *Cinchona officinalis* and No. 2 *Cinchona succirubra*.

The barks were examined at the Imperial Institute with the following results, compared with those obtained in the case of two small samples of the barks received from St. Helena in April 1917.

| | Present samples. | | | | Previous samples. | | | |
|---|---|---|---|---|---|---|---|---|
| | No. 1. | | No. 2. | | No. 1. | | No. 2. | |
| | Bark as received. | Moisture-free bark. | Bark as received. | Moisture-free bark. | Bark as received. | Moisture-free bark. | Bark as received. | Moisture-free bark. |
| | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* |
| Moisture . . | 9·4 | — | 8·6 | — | 9·0 | — | 7·8 | — |
| Total alkaloid . | 8·3 | 9·2 | 8·5 | 9·3 | 9·8 | 10·8 | 8·7 | 9·4 |
| Yield of crystallised quinine sulphate . . | 8·2 | 9·1 | 4·6 | 5·1 | 8·8 | 9·7 | 3·8 | 4·1 |
| Equivalent to quinine (anhydrous) . . | 6·1 | 6·7 | 3·4 | 3·7 | 6·5 | 7·1 | 2·8 | 3·0 |

The results of the present examination are in general agreement with those recorded for the small samples previously examined. The present sample of bark No. 1 contained less total alkaloid than the earlier sample, but the percentage of quinine was nearly the same; bark No. 2 contained about the same amount of total alkaloid as the previous sample and rather more quinine. In both cases the amounts of alkaloid are above the average for *C. officinalis* and *C. succirubra*. The alkaloid of bark No. 1 is principally quinine, whereas a much smaller proportion of quinine is present in bark No. 2. These facts are in agreement with the suggestion that No. 1 may be *C. officinalis* and No. 2 *C. succirubra*.

The barks were submitted for valuation to brokers and quinine manufacturers, who furnished the following reports on their quality and values.

(1) The brokers described No. 1 as well-grown bark, which would be suitable for manufacturing purposes, and valued it at 1*s.* 8½*d.* per lb. in London (February 1918). They considered that No. 2, in the condition of the sample, would be worth 11½*d.* per lb. to manufacturers, but stated that if carefully prepared it might be marketable as *Cinchona succirubra* for druggists' use, when it would realise a higher price.

(2) The manufacturers stated that, judging from appearance, No. 1 represented *C. officinalis* bark, and No. 2 *C. succirubra* bark, which, in view of their richness in quinine, would be worth about 1*s.* 6*d.* per lb., and 10*d.* per lb. respectively in London at the present time for manufacturing purposes. The firm added, however, that under normal conditions the *C. succirubra* bark would be saleable to druggists at a higher price.

It may be mentioned that the pre-war values of these cinchona barks for manufacturing purposes would have been about half the prices now quoted.

These cinchona barks from St. Helena were of good quality, and there is no doubt that consignments similar to the samples would find a ready market in London at the present time.

## East Africa

Cinchona is grown on several European plantations, and at the gardens of the Amani Institute in Tanganyika Territory, the former German Colony in East Africa. According to the Annual Report of the Amani Institute for 1912–13, about 60 cwt. of bark were produced there in that year (*Der Pflanzer*, 1914, **10**, 44). The four samples of cinchona bark from East Africa, described in the following report, were received at the Imperial Institute for examination in February 1918, and were stated to represent the barks of *Cinchona robusta*, *C. succirubra*, *C. Ledgeriana*, and a hybrid between *C. Ledgeriana* and *C. succirubra*.

No. 1. "*Cinchona robusta, B.L.I. Amani.*"—This sample consisted of quilled chips, somewhat broken and varying from moderately large to very small and thin. The outer surface of the chips are brown, and covered with lichen in a few cases, while the inner surface was a light warm brown colour.

No. 2. "*Cinchona succirubra.*"—This consisted of quilled chips, rather broken, and of variable size, chiefly fairly thick. The chips were of light warm brown colour, rather darker on the outer surface, and showed occasional patches of lichen.

No. 3. "*Cinchona Ledgeriana.*"—This consisted of quilled chips, of mixed size, some pieces being fairly thick and others thin and narrow. The outer surface of the chips was of a warm brown colour, and mostly covered with lichen, while the inner surface had a light brown colour. The sample was somewhat broken.

No. 4. "*Hybrid C. Ledgeriana* × *C. succirubra.*" This sample consisted of thick, large quilled chips, of a warm brown colour on the outer surface, which was mostly covered with lichen, and light brown on the inner surface.

The value of cinchona barks of these types depends chiefly on the amount of quinine sulphate obtainable from them, and this in turn depends on the process used by the quinine manufacturer. For this reason samples of the barks were submitted to a British firm of quinine manufacturers for examination and valuation. The results

of the chemical examination of the four samples are shown in the following table:

| | No. 1. *C. robusta.* | No. 2. *C. succirubra.* | No. 3. *C. Ledgeriana.* | No. 4. *C. Ledgeriana* × *C. succirubra.* |
|---|---|---|---|---|
| | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* |
| Moisture . . . . | 8·1 | 7·9 | 8·9 | 7·5 |
| Total alkaloid . . . | 7·61 | 8·32 | 5·00 | 11·30 |
| Quinine . . . . | 2·66 | 2·54 | 3·81 | 8·41 |
| Cinchonidine . . . | 3·51 | 2·05 | nil | nil |
| Yield of crystallised quinine sulphate . . . . | 3·55 | 3·39 | 5·08 | 11·21 |

No. 1. *Cinchona robusta.*—The bark of this species generally contains 5 to 6 per cent. of total alkaloid, including 2 per cent of quinine. The present sample, therefore, contains a high percentage of both total alkaloid and quinine.

No. 2. *Cinchona succirubra.*—This sample represents a good quality of *C. succirubra* bark, which usually contains from 1½ to 3 per cent. of quinine and about the same amount of cinchonidine.

No. 3. *Cinchona Ledgeriana.*—This contains a rather low percentage of alkaloid for the species it represents, as Ledger bark usually yields about 7 per cent. of total alkaloid, about 5 per cent. of quinine, and little or no cinchonidine. These figures are sometimes exceeded, the total alkaloid reaching 12 per cent. and the quinine 10 per cent.

No. 4. *Ledgeriana Hybrid.*—The Ledgeriana hybrids are similar in composition to Ledger bark, containing high percentages of quinine and little or no cinchonidine. The present sample of hybrid bark is of very good quality, yielding 11·30 per cent. of total alkaloid and 8·4 per cent. of quinine alkaloid. This bark is the most valuable of the four samples received.

It is recorded in *Der Pflanzer* (1906, 2, 336) that two samples of bark taken in 1906 from four-year-old trees of hybrids *C. Ledgeriana* × *C. succirubra* at Amani yielded 6·47 and 6·80 per cent. of quinine sulphate respectively. In the latter sample the total alkaloid was 6·77 per cent., of which 4·84 per cent. was quinine. The present sample of the hybrid bark is therefore considerably richer in total alkaloid and quinine than those two samples of young bark.

The firm of quinine manufacturers to whom the samples were submitted reported that for their purpose the present values of barks of the composition shown in the table of analyses and ex London warehouse would be as follows:

| | Per lb. | | Per lb. |
|---|---|---|---|
| No. 1 . . | . 8½d. | No. 3 . . | 1s. 0½d. |
| No. 2 . . | . 8½d. | No. 4 . . | 2s. 3d. |

For comparison with these prices it may be stated that the normal approximate values of these barks on the basis of the prices current immediately before the war would be:

| | Per lb. | | Per lb. |
|---|---|---|---|
| No. 1 . . | . 3½d. | No. 3 . . | 5d. |
| No. 2 . . | . 3½d. | No. 4 . . | 11½d. |

The manufacturers stated that sample No. 4, the hybrid from *C. Ledgeriana* × *C. succirubra*, is one of the highest quinine-yielding barks they have examined, being fully equal to the finest Ledger bark from Java.

The results of this investigation show that these samples of cinchona bark from East Africa are all of good quality, and that the hybrid bark (No. 4) is exceptionally rich in quinine. There would be no difficulty in disposing of consignments of similar bark to quinine manufacturers at the prices given in this report, which are much higher than those ruling before the war, and represent about 2½*d.* per lb. for every unit per cent. of quinine sulphate yielded by the bark. The pre-war price was about 1*d.* per lb. per unit per cent. of quinine sulphate.

Under normal market conditions the *Cinchona succirubra* bark might be saleable for pharmaceutical use at a higher price than that quoted above, but recently there has been very little market for pharmaceutical bark.

The manufacturers to whom the first samples of East African bark were submitted for valuation expressed a desire to purchase a shipment of the bark, and in 1919 a consignment was forwarded to the Imperial Institute by the Acting Administrator of German East Africa.

The consignment consisted of 52 bags of cinchona chips (net weight 61 cwt. 0 qr. 27¾ lb.), which were apparently derived from *Cinchona succirubra*, and 1 bag

of quills (net weight 60 lb.), which more resembled the *C. Ledgeriana* type of bark.

Samples of the chips and the quills were submitted to chemical examination at the Imperial Institute with the following results:

| | Chips. Per cent. | Quills. Per cent. |
|---|---|---|
| Moisture | 8·8 | 10·9 |
| Total alkaloids | 5·86 | 4·46 |
| Including quinine[1] | 1·81 | 3·79 |
| [1] *Equivalent to crystalline quinine sulphate* | 2·45 | 4·61 |

It will be seen from these figures that the total alkaloic present in the quills amounted to 4·46 per cent. and wa mainly quinine, whereas the chips contained 5·86 per cent of total alkaloid, of which, however, only 1·81 per cent was quinine.

The chips were purchased by the manufacturers a 5½*d.* per lb., and the quills at 11*d.* per lb.

The consignment of chip bark contained less quinin and less alkaloid than the sample of *C. succirubra* bar from Tanganyika which was received at the Imperia Institute in 1918. The latter material yielded 3·39 pe cent. of crystalline quinine sulphate compared with 2·4 per cent. from the present consignment.

The quills resembled the *C. Ledgeriana* bark examine in 1918 in yielding about the same amounts of quinine an total alkaloid.

The results of the investigation confirm the viev that cinchona bark of good quality can be grown i Tanganyika, although the two samples of *C. succirubr* bark have shown variation in the amounts of tota alkaloid and quinine present. It would, therefore, appea desirable to take steps to extend the plantations o the trees, particularly those of the *C. Ledgeriana* type with a view to the production of bark for British manu facturers.

## CAMEROONS

Cinchona has been produced from experimental planta tions established by the Germans at Buea in the Cameroon and four samples of bark from these plantations were re

ceived from the Government of Nigeria for examination at the Imperial Institute in 1918.

It was stated that the samples were obtained by stripping the bark from the trees and drying it in the sun.

Sample No. 1 was collected from trees growing at an elevation of about 3,000 ft.; samples Nos. 2 and 3 were from a plantation about 200 ft. higher up the Cameroon mountain, and No. 4 was from a plantation at a still higher altitude.

The four samples were similar in appearance, and consisted of quilled pieces of natural bark, about 20 in. in length, from ¾ to 1½ in. in width, and from ⅛ to ⅜ in. in thickness. The outer surface was in many cases covered with lichen. The inner surface was dark reddish-brown, and the fracture was light brown.

The barks were analysed at the Imperial Institute with the following results:

| | No. 1. *Per cent.* | No. 2. *Per cent.* | No. 3. *Per cent.* | No. 4. *Per cent.* |
|---|---|---|---|---|
| Total alkaloids . . . | 7·5 | 6·3 | 7·0 | 8·3 |
| Moisture . . . . | 9·9 | 10·2 | 10·3 | 10·1 |

As the value of cinchona barks of these types depends chiefly on the amount of quinine obtainable by the process used by the quinine manufacturers, samples of the bark were submitted to a British firm of quinine manufacturers for further examination and valuation. The following results were obtained:

| | No. 1. *Per cent.* | No. 2. *Per cent.* | No. 3. *Per cent.* | No. 4. *Per cent.* |
|---|---|---|---|---|
| Quinine alkaloid . . | 6·14 | 5·05 | 5·27 | 5·28 |
| Cinchonidine . . . | 6·55 | 0·24 | 0·23 | 1·17 |
| Yield of crystalline quinine sulphate . . . | 8·19 | 6·73 | 7·02 | 7·04 |

These results show that all the samples are of good quality, furnishing from 6·7 to 8·2 per cent. of quinine sulphate, and consignments of similar quality would be very suitable for the manufacture of quinine sulphate.

As regards the value of the barks from the Cameroons, the pre-war value of cinchona barks was about 1*d.* per lb. per unit per cent. of quinine sulphate, but the price for delivery up to the end of 1918 was 2*d.* per lb. per unit.

The value at the end of 1918 and the pre-war value of the barks on this basis are shown in the following table :

| Sample. | Value at end of 1918. *Per lb.* | Pre-war value. *Per lb.* |
|---|---|---|
| No. 1 . . . . | 1s. 4d. | 8d. |
| No. 2 . . . . | 1s. 1½d. | 6d. to 7d. |
| No. 3 . . . . | 1s. 2d. | 7d. |
| No. 4 . . . . | 1s. 2d. | 7d. |

It appears probable that samples 1, 2 and 3 were derived from the " Ledger type " of cinchona, whilst sample 4 was probably derived from a hybrid.

The results of this investigation show that these cinchona barks from the Cameroons are of good quality, as they furnish more quinine sulphate than average cinchona bark from Java, which is now the principal source of supply. It is possible, however, that when the trees are regularly stripped for the production of bark the percentage of quinine may be diminished.

In submitting this report to the Governor-General of Nigeria it was requested that information should be furnished to the Imperial Institute as to whether commercial supplies of these barks could be furnished from the Cameroons Province, and if so the quantities available. It was also pointed out that it would be of interest to learn the species of Cinchona from which the samples were derived. In response to this request the following information has been received.

According to the Director of Agriculture, " Commercial, but not large, quantities of these barks could be supplied from the Cameroon Province. It would be necessary to re-examine the plantations in the light of this Report in order to determine the possible output. In any case, that from the plantation from which Sample No. 3 was obtained would be very small, as this plantation has been neglected in recent years, so that many of the trees have died and the others are badly grown for the greater part." He added that a nursery of over 500 plants had been made at Buea, which was making good progress in July 1918.

The Resident, Buea, at a later date, however, reported that the present quantity of trees would not furnish commercial supplies of cinchona bark. He had taken the

opinion of the Acting Supervisor of Plantations and the Manager of Molyko Plantation, both of whom had been familiar with cinchona trees in Ceylon, and they state that all the trees in question are of the Ledger variety. The Resident further states that there are no other quinine trees in the Province, either in the Botanical Garden at Victoria or among the plantations.

## IV

## REPORT ON THE TRADE IN INDIAN MYROBALANS[1]

THE myrobalans of commerce consist of the dried fruits of species of Terminalia, principally *Terminalia Chebula*, Retz., the chebulic or black myrobalan. They are one of the principal tanning materials produced in India, and in addition to their local use are largely exported. No statistics of the total production of myrobalans in India are available, but the following summary will indicate the extent of the export trade.

### INDIAN EXPORTS OF MYROBALANS

The myrobalans exported from India are entirely an Indian product. There are no imports for re-exportation. Table I attached shows the quantities and values of myrobalans exported from India in the nine years 1910–11 to 1918–19, and also the countries of destination.

*Pre-war Trade.*—During the four years previous to the war (1910–11 to 1913–14) the exports averaged in weight about 1,400,000 cwt., and in value nearly £400,000. From 40 to 50 per cent. of the pre-war exports, varying in value from £129,500 to £188,500 annually, were despatched from India to other parts of the British Empire—almost entirely to the United Kingdom.

Outside the United Kingdom, the best buyers, in the order of their importance, during the four years in question, were Germany, the United States and Belgium. Germany's share of the exports averaged 260,000 cwt. annually, or about one-fifth of the total; it is noteworthy, in this connection, that in the four months of 1914–15 which

[1] The Special Committee on Hides and Tanning Materials had previously furnished a series of reports on Indian Hides and Skins. These have been published under the title of "Reports on Hides and Skins" as the first volume of the Indian Trade Enquiry Reports.

preceded the outbreak of war the shipments to Germany amounted to nearly half the quantity exported to that country in the preceding year. Austria-Hungary was the only other enemy country which took any considerable amount of Indian myrobalans, viz. from 37,000 to 47,000 cwt. annually, or about 3 per cent. of the total.

Previous to the war the shipments to the United States averaged 225,000 cwt. annually, or about one-sixth of the total exports; and to Belgium 160,000 cwt. annually, representing about one-ninth of the total. France (from about 2½ to 4 per cent.), Italy (from 1 to 2 per cent.), Russia (from 1 to 2 per cent.), and Japan (less than 1 per cent.) were all regular buyers of Indian myrobalans. Altogether allied countries took before the war about one-third of the total exports.

### *Trade during the War*

Subsequent to the outbreak of war the exports of myrobalans from India declined slightly to an average of 1,200,000 cwt. annually in the three years 1914–15 to 1916–17, and fell to 815,550 cwt. and 823,890 cwt. in 1917–18 and 1918–19 respectively. This drop in the exports is to be attributed to the shortage of freight.

During the war the exports were principally taken by the United Kingdom, the only other important buyer being the United States, as will be seen from the following table:

| | 1914–15. *cwt.* | 1915–16. *cwt.* | 1916–17. *cwt.* | 1917–18. *cwt.* | 1918–19. *cwt.* |
|---|---|---|---|---|---|
| Total exports . | 1,164,261 | 1,392,663 | 1,081,209 | 815,550 | 823,890 |
| To United Kingdom . | 644,399 | 937,037 | 796,531 | 717,479 | 655,086 |
| To United States . | 189,338 | 267,417 | 133,668 | 40,310 | 49,993 |

During these five years the United Kingdom took 70 per cent. of the myrobalans exported from India. It may be noted that Japan increased her imports of Indian myrobalans during the war, and in 1916–17 took 45,331 cwt., or about 4 per cent. of the total.

## United Kingdom Trade in Myrobalans

Statistics of the imports of myrobalans into the United Kingdom, and of the re-exports, are given in the appended

Table II. India has practically a monopoly of the supply, as will be seen from the following summary of the figures:

| Year. | Total imports of Myrobalans into the United Kingdom. cwt. | From British India. cwt. |
|---|---|---|
| 1911 | 515,216 | 511,222 |
| 1912 | 576,624 | 572,122 |
| 1913 | 565,222 | 564,462 |
| 1914 | 560,600 | 559,100 |
| 1915 | 778,984 | 770,906 |
| 1916 | 861,729 | 860,871 |
| 1917 | 674,377 | 674,377 |
| 1918 | 748,130 | — |

The United Kingdom imports of myrobalans are almost wholly for home use, the maximum re-exports during the last eight years being 35,479 cwt. in 1916.

## Collection of the Fruits in India

*Terminalia Chebula*, the principal source of the myrobalans of commerce, is a large or small deciduous tree, which, according to Gamble, is found throughout India and Burma, chiefly in deciduous forests, but also occasionally in rather moist mixed forests. In high-level rocky and dry places on the outer Himalaya, the hills of the Deccan and South India, it is quite a small tree, but in valleys and forests of big trees it also grows big and gives a hard dark-coloured timber. In the outer Himalaya it may be found up to 5,000 ft., and to almost as high in the Nilgiris and other South Indian ranges. It is a very variable tree (the Flora of British India enumerates six varieties) and the fruits vary greatly in size and degree of angularity. Gamble suggests that some of the varieties might be better treated as species.

Myrobalans are entirely a forest product, and are one of the most valuable of the minor sources of forest revenue. The supplies are derived from forests belonging to the Government of India or to Native States and from privately-owned forests, but no data are available to show the proportions of the total crop from these three sources.

As a general rule, each season's crop is sold by tender while on the trees, the buyers assuming the risk of out-

turn and undertaking the work of gathering the nuts, etc. Tenders are usually called for in May and June for one season or longer, and there have been instances of merchants buying the right of collecting nuts from certain forests for a period of five years. For some years before the outbreak of war a Combination of the largest Indian dealers was successful in securing the bulk of the contracts. After collecting and drying, the nuts were brought down to the warehouses and were there sorted and cleaned by Indian women workers before being packed in bags or pockets for shipment.

The up-country warehouses in which the nuts are stored consist merely of sheds with roofs of palm-leaves, whilst in some of the Native States the nuts are allowed to lie in heaps at the railway-stations fully exposed to the weather until freight is available. The provision of proper storage accommodation would prevent considerable deterioration in the quality of the nuts.

It is understood that certain European firms have on more than one occasion considered the possibility of purchasing the crop, but that upon investigation they decided they could not compete successfully with the Indian merchants, who are more capable of obtaining and controlling the considerable Indian labour required to pick and sort the nuts. In addition, no trustworthy data are available as to the yield of nuts in previous years, and it is therefore difficult for European firms to estimate the price which should be offered.

The Combination, having secured the nuts, were in the habit of making consignments to East India merchants, who allowed them to draw at three months' sight against shipments. When shipments were made against sales to arrive, the tenders were not always up to standard, with the result that allowances had to be made to buyers in certain cases, ranging from 1½*d.* per cwt. to 6*d.* or 9*d.* per cwt. Most of the business was done either in London or Liverpool. Some contracts were made direct between the native Combination in Bombay and certain German firms in Hamburg, who bought on c.i.f. terms, a clause in the contract usually calling for London arbitration.

The Combination has its own standards of the leading

qualities, and more than once these standards have been objected to by buyers on the ground that they were too low in quality. It generally appeared, however, that the trade accommodated itself to the standards that were supplied, and, so far as is known, neither tanners nor dyers ceased to buy myrobalans because they failed to secure a quality of nuts exactly suitable for their purpose.

The Combination has not exercised complete control of the industry except in certain districts, as there are numerous small dealers who take up contracts in Government forests independently of the Combination.

There are five principal varieties of myrobalans recognised in commerce, and usually two grades of each variety. The varieties, which are named after the districts in India from which the fruits are obtained, are as follows : " Bimlies," or " B's," from Bimlipatam, in Madras ; " Jubbelpores," or " J's," from Jubbulpore in the Central Provinces (obtained partly from British territory and partly from the Native State of Rewah) ; " Rajpores," or " R's," from the Kohlapur State ; " Vingorlas," or " V's," from the Bombay forests ; and " Coast Madras." Each of these different varieties is usually separated into two grades known as No. 1 and No. 2.

## Time of Collection of the Fruits

There has been some uncertainty as to the best time to gather myrobalans owing to the absence of definite information as to whether the fruits are richer in tannin when immature or when fully ripe. At a conference on Indian tanning materials which was held at the Colonial and Indian Exhibition in London in 1885 the tanning experts selected, as the best type of myrobalans for their requirements, a pointed oval specimen, solid in structure and of a pale greenish-yellow colour in section, which was afterwards identified as the immature fruit of *Terminalia Chebula*. It was subsequently reported (*Selections from the Records of the Government of India*, Rev. and Agric. Department, vol. 1, part 1 (No. 9, 1888–89) that analyses of specimens of myrobalans to determine their richness in tannin had confirmed the valuations of the experts.

Hence the opinion was formed that immature myrobalans contain the maximum percentage of tannin.

In this connection, however, four samples of the fruits of *T. Chebula* from India examined at the Imperial Institute in 1895 were found to vary very widely in the amount of tannin present, viz. from 13·3 to 38·9 per cent., and the sample which exhibited most strongly the characters condemned by the tanning experts was the richest in tannin.

At a later date three samples of half-ripe fruits, ripe fruits and over-ripe fruits from the same tree growing in the Poona district of Bombay were examined at the Imperial Institute. These were found to contain 38·54, 44·76 and 37·83 per cent. of tannin respectively, indicating that the ripe fruits contain the largest proportion of this constituent, and would therefore be of most value for tanning purposes.

This question of the relative amounts of tannin present in the unripe and ripe fruits has since been further investigated by Puran Singh in India. Reporting on the examination of nine specimens collected in South Thana, Bombay, Puran Singh states (*Indian Forester*, vol. 37 (1911), p. 509): "The fruits that have remained longest on the tree, i.e. those quite ripe, should be classed as the richest in tannin, irrespective of their colour." This conclusion is slightly modified by Puran Singh in a subsequent paper (*Indian Forester*, vol. 41 (1915), p. 17), where he states that his former opinion in favour of the collection of myrobalans when perfectly ripe is supported by an investigation of the tannin strength of thirty-five samples from Madras and Balaghat; but, he adds, that "instead of allowing the myrobalans to remain as long as possible on the tree, as suggested in the previous note, it is recommended that they should be collected as soon as they are fully ripe."

It must, however, be borne in mind that myrobalans are not always used for the same purpose in tanning, and that a high percentage of tannin is not invariably accompanied by the other qualities required. There has certainly been much variation in the past in the opinions and purchasing practices of tanners with regard to myrobalans, and cases have been known of tanners obtaining an

allowance on account of consignments which have proved to contain more tannin than the original sample. The fact is that, as Parker and Blockey have pointed out in a paper on this subject (*Journal of Society of Chemical Industry*, 1903), " myrobalans are bought by one tanner for a purpose totally different from that for which his neighbour buys a different variety ; some tanners using them simply for their strength and their apparent cheapness when compared with the price of oak bark and valonia ; others using them on account of their brightening colour ; others because of the light-coloured bloom they deposit on and in the leather ; whilst again many tanners value myrobalans on account of their power to produce liquors rich in natural acids to be used in the early stages for plumping their young goods."

### Composition of Myrobalans

Analyses of eleven commercial samples of myrobalans of average quality were made by Parker and Blockey in the course of their investigation of myrobalans referred to above, with the result that the following varieties were found to contain the highest proportions of tannin : B No. 1 (43·6 per cent. in the dry material) ; J No. 1 (41·5 per cent.) ; R No. 1 (40·2 per cent.) ; and B No. 2 (40·0 per cent.). These investigators also compared the samples for weight-giving properties ; for bloom-yielding capacities ; and for the development of acidity in the liquors.

The tests for weight-giving properties showed that J's were considerably more valuable in this respect than any of the other varieties, and that there was little to choose between B's and R's. Moreover, in every case the No. 2 grade yielded the greatest weight, while the No. 1 quality seemed usually better than the picked.

With regard to bloom-yielding capacity, J's and V's were found to be distinctly superior to all the others. Not only did they lead in the final result, but a large part of the bloom was deposited during the early stages of the process, whereas in nearly all the other cases the greater part of the bloom was deposited later.

In the acidity tests, B's were found to develop the most acidity and J's the least.

Parker and Blockey also calculated the cost of 1 per cent. of tannin per ton in the different varieties of myrobalans, and found that it varied from *2s. 2·6d.* in the case of Bimlies No. 2, to *4s. 3¾d.* in the picked Bimlies.

The amounts of tannin present in Indian myrobalans are illustrated by the following figures:

| | Percentage of tannin in dry material. Minimum. | Maximum. |
|---|---|---|
| *Samples examined at the Imperial Institute:* | | |
| Bombay (43 samples) | 27·9 | 47·0 |
| Madras (15 samples) | 21·8 | 49·8 |
| Burma (7 samples) | 8·6 | 34·4 |
| Commercial Samples: | | |
| Bimlies—B 1 | 36·0 | |
| B 2 | 30·3 | |
| Jubbelpores—J. 1. | 38·5 | |
| J. 2. | 28·3 | |
| Rajpores—R 1 | 39·6 | |
| R 2 | 27·0 | |
| Vingorlas—V 1 | 32·9 | |
| V 2 | 27·0 | |
| *Samples examined by Parker and Blockey:* | | |
| Bimlies—Picked | 37·5 | |
| No. 1 | 43·6 | |
| No. 2 | 40·0 | |
| Jubbelpores—Picked | 32·8 | |
| No. 1 | 41·5 | |
| No. 2 | 31·0 | |
| Rajpores—Picked | 36·6 | |
| No. 1 | 40·2 | |
| No. 2 | 31·4 | |
| Vingorlas—No. 1 | 35·8 | |
| Fair Coast Madras | 39·5 | |
| *Samples examined by Puran Singh:* | | |
| Madras (32 samples) | 44·1 | 68·1 |
| Central Provinces (3 samples) | 54·0 | 61·1 |

It will be noticed that the percentages of tannin found by Puran Singh are much higher than the other results quoted.

## The Use of Myrobalans by British Tanners

The Committee have consulted tanning experts as to the use of myrobalans in the United Kingdom, and the following account summarises the opinions obtained

under the five heads: (1) the purposes for which myrobalans are chiefly required by British tanners; (2) the types of myrobalans which they prefer; (3) the form in which they prefer to buy myrobalans, e.g. as the whole fruits or as the crushed fruits freed from stones; (4) the use of myrobalans extract; and (5) the possibility of extending the use of myrobalans in the United Kingdom.

1. The purpose for which myrobalans are chiefly required by British tanners.

Myrobalans are extensively employed in the United Kingdom for tanning both hides and skins, but they are usually blended with other tanning materials and not used alone. Myrobalans alone are not a satisfactory tanning material, as they give a soft, spongy leather, which does not possess good wearing properties. They are, however, very useful when blended with other materials such as quebracho, mimosa bark, mangrove bark, hemlock bark and extract, chestnut extract, and gambier. The proportions of myrobalans used will vary with the nature of the leather required, but in making sole leather the following mixed tannages are generally employed:

Quebracho with 25 to 30 per cent. of myrobalans nuts;
Mimosa bark with 15 to 20 per cent. of the nuts;
Mangrove bark with up to 50 per cent. of the nuts.

The advantages derived from the use of myrobalans in such mixed tannages are:

(*a*) they help to improve the colour of the leather;
(*b*) they impart mellowness to the leather;
(*c*) they deposit bloom on the fibres of the leather;
(*d*) they undergo fermentation with the production of acid liquors which are necessary in the early stages of tanning to swell or plump the hides. This is the most important feature of myrobalans when used for the production of sole leather, and in conjunction with their relative cheapness probably accounts for their extensive use by British tanners.

2. The types of myrobalans preferred by British tanners.

The varieties of myrobalans preferred by British tanners vary according to the particular type of leather

which it is desired to produce; but the three most popular kinds are stated to be Bimlies, Jubbelpores and Vingorlas.

3. The form in which British tanners prefer to buy myrobalans.

Hitherto British tanners have preferred to purchase the whole nuts rather than the crushed nuts freed from the stones. This preference has been chiefly due to the facts that (*a*) the condition of the whole nuts can be more readily seen by inspection, and (*b*) the crushed material is frequently of inferior quality and is often packed in a damp condition, with the result that it becomes sticky and forms solid lumps which cannot be ground or completely extracted. Moreover, many of the pieces of the crushed material are too large to be readily extracted.

Another consideration in favour of the whole nuts is that the spent material can be readily burnt on account of the oil present in the seeds, whereas the crushed material freed from the stones is difficult to dispose of in this way. This point is of some importance to tanners in towns where land is not available to deposit the waste material.

The whole nuts have hitherto been bought chiefly on appearance, the light-coloured nuts being preferred and a higher price paid for them. This method of valuation has, however, been shown to be unscientific, as the darker nuts frequently contain more tannin than the light-coloured nuts and yield a leather of only slightly darker shade. It would, therefore, be more satisfactory to base the valuation on the amount of tannin present, and to control these valuations by determinations of the colour. The absence of unsound nuts in consignments is stated to be of more importance to the tanner than the colour of the sound nuts.

The tanning experts who were consulted by the Committee expressed the opinion that if the preparation of crushed myrobalans in India could be improved the principal demand would ultimately be for the material in this form, and it was stated that the crushed myrobalans has always been the cheaper material per unit of tannin. It was suggested that it would be advantageous (*a*) if the nuts were carefully picked over in India and the unsound nuts rejected before crushing; (*b*) if the crushing could be improved; and (*c*) if the material were thoroughly

dried before shipment. It is understood that the crushing is usually done with very primitive appliances, and could be greatly improved by the use of proper machinery.

With reference to the different commercial varieties and grades of myrobalans it is thought that it will not be possible to abolish these, owing to the prejudices of the trade. Some tanners, for example, insist on having B (1)s or J (1)s and will not purchase other grades. If, therefore, the preparation of crushed myrobalans were generally adopted it would probably be necessary to crush the different varieties separately, at any rate in the case of Bimlies and Jubbelpores, but possibly the other kinds might be all crushed together. Some tanners would no doubt demand the No. (1)s crushed separately from the No. (2)s, but it might ultimately be possible to crush the two grades together.

The crushed material would be more liable to adulteration than the whole nuts, and it would be an advantage if sales could be made on the basis of analysis made in the United Kingdom.

4. The use of myrobalans extract.

Opinions were obtained as to whether it would be feasible to extend the production in India of myrobalans extract, either (1) liquid, or (2) solid, for export instead of the whole or crushed nuts. As regards (1) liquid extract, there would be no advantage in preparing a liquid extract of myrobalans for export, this product would contain less tannin than the crushed myrobalans (about 45 per cent.) and no more tannin than the whole nuts (about 30 per cent.), and would, moreover, be more difficult to ship.

With regard to (2) the solid extract, it is stated that this product is much inferior to the nuts as a tanning agent, as it does not give the particular advantages obtained with the nuts, viz. an improvement of colour, a deposition of bloom, and the formation of acid liquors. In general, solid extracts are not so satisfactory for tanning purposes as the original material, and in the case of myrobalans it would appear preferable to export the crushed nuts from India rather than to attempt to develop the production of a solid extract.

Considerable quantities of myrobalans extract are made in the United Kingdom for use by tanners and dyers, but this is entirely in the liquid form.

5. The possibility of extending the use of myrobalans in the United Kingdom.

The quantity of myrobalans used annually in the United Kingdom showed little variation in the years 1911–14, but rose considerably during the war owing to the increased production of leather. Large quantities of upper leather are now being manufactured in the United Kingdom from Indian kips and light hides, and myrobalans are a very satisfactory material for this purpose. If, therefore, the tanning of Indian kips can be permanently established in the United Kingdom, it seems likely that the increased demand for myrobalans will be maintained.

### The Use of Myrobalans by British Dyers

In addition to their use for tanning purposes, myrobalans are also employed, but to a less extent, in the dyeing industry. The following information as to the use of myrobalans by British dyers was obtained by the Committee.

Myrobalans are chiefly used by dyers in the " Heavy Woollen District " of Yorkshire. The cloth manufactured in this district is made in part from " shoddy " and in part from cotton, and usually contains from 50 to 70 per cent. of cotton. Myrobalans are largely employed for dyeing the cotton. The pieces of cloth are first passed through water containing finely ground myrobalans in suspension, or an equivalent quantity of myrobalans extract, and then through a bath containing nitrate of iron. By this means the cotton is dyed black, whilst the wool is not affected. The colour withstands the action of soap, but is weakened by dilute acids.

The use of myrobalans for this purpose has latterly been somewhat reduced by the introduction of a Cotton Milling Black by the German dye manufacturers, whereby the cotton can be dyed whilst the cloth is going through the milling process, thus saving time and labour. If, however, fastness to acids is not essential, the myrobalans process is preferred, as it adds weight to the cloth.

Myrobalans in the form of extract have also been employed in the Bradford trade for dyeing certain classes of dress materials containing cotton, but their use for this purpose is gradually declining. The cotton warps were formerly dyed with myrobalans and iron previous to weaving, but in the process now used the wool is subsequently dyed with acid colours and this treatment reduces the colour of the myrobalan-dyed cotton. In order to avoid this difficulty myrobalans are being largely superseded for this purpose by Direct Dyeing Blacks which will withstand the acid treatment.

Myrobalans are also used to some extent in the cotton dyeing industry in Lancashire as a mordant for the basic aniline dyes. Myrobalans, however, contain a yellow colouring matter (quercetin), which renders them unsuitable for use as a mordant for bright shades on cotton or silks, as the yellow dulls the colours obtained.

Another use of myrobalans in the dyeing industry is for cleaning fabrics dyed with indigo. The dye rubs off slightly from the freshly dyed material when either natural or synthetic indigo is used, and the surplus dye cannot be removed by treatment with soap and water. It can, however, be got rid of by means of a solution of quillaia bark or myrobalans. The demand for myrobalans for this purpose is, however, only comparatively small.

It does not appear probable that the use of myrobalans in the dyeing industry will increase, but the present demand may be maintained. Dyers require tannins of the pyrogallol class, and the only suitable materials available are sumach and myrobalans. Sumach is much dearer than myrobalans, and hence the latter material is generally used. Sumach, however, gives brighter colours than myrobalans, as it contains no yellow colouring matter like the latter. The pre-war prices for myrobalans were quite satisfactory to dyers, and the price might rise without affecting the demand, as myrobalans will always be cheaper than sumach, which is the only alternative material.

The colour of the dye obtained with myrobalans varies with the different varieties of the nuts. Thus, for example, J (1)s give a bluer black than J (2)s. For

dyeing purposes J (1)s, B (1)s, V (1)s, and Madras are very good, but the No. (2)s of the J and B varieties are preferred by dyers, and can be generally bought for about 20 per cent less. The No. (2)s usually contain less tannin, but a larger proportion of the yellow colouring matter, which is no detriment, but rather an advantage, as they give a blacker shade on the cotton. R (2)s and V (2)s are the least suitable for use by dyers, and are never purchased unless other sorts are scarce.

With regard to the form in which dyers prefer to purchase myrobalans it was stated that the demand is for the entire nuts ground into fine powder, or for the extract. The crushed fruits cannot be used in the dye-bath because they would cut the cloth in passing with it through the rollers. A liquid extract of myrobalans is now largely used by dyers instead of the finely ground nuts, on account of the River Pollutions Act.

## Suggestions with Respect to the Future Trade in Myrobalans

### *Collection and Grading of Myrobalans*

With reference to the collection of the nuts in India the Committee do not consider that it will be possible to alter the present arrangements, which are largely in the hands of a combination of Indian firms. The collection of the nuts is essentially an Indian industry, and it is believed that it would be difficult to establish a European organisation for the purpose on a paying basis. Improvements in the condition of the nuts might, however, be effected if better storage accommodation were provided up-country, particularly in some of the Native States, where the nuts, after collection, are often left exposed to the weather, and consequently suffer considerable deterioration.

The grading of the nuts could also be improved. This work is usually carelessly done, and the standards of the grades have been lowered from time to time by the combination of Indian firms. Complaints on these points have been made by buyers in the United Kingdom, but the grades offered meet with a ready sale, and an increase

in the price of the No. (1)s reduces the demand for this quality and stimulates that for the No. (2)s. In these circumstances there is, unfortunately, little inducement to improve the grading in India. It would, however, be a great advantage if the nuts were carefully sorted before shipment and all unsound specimens rejected.

The Committee have considered the question as to whether it is necessary to continue the separation of the different varieties of myrobalans into two grades, Nos. 1 and 2. It is stated that the Cawnpore tanneries do not buy graded myrobalans, but, on the other hand, British tanners attach great importance to the grading, and in many cases they purchase only particular grades. In view of this fact it would appear necessary to continue the present method of grading in India.

At present myrobalans are purchased by British tanners largely on appearance, which has been shown to be an unsatisfactory method of valuation, and it would be better if they were sold on a unit-tannin basis, controlled by colour determinations. It must, however, not be overlooked that myrobalans are often bought by tanners, not solely for the tannin present, but also for their other properties.

*Form in which Myrobalans should be Exported*

Up to the present, British tanners have preferred to purchase myrobalans in the form of the entire nuts, but recently increased quantities of the crushed myrobalans (freed from the stones) have been imported. It is thought that if the preparation of the crushed myrobalans were improved the bulk of the demand would eventually be for the material in this form. The Committee are of opinion that it would be advantageous if an arrangement could be made for the regular supply of crushed myrobalans, the crushing to be carried out at convenient centres in India under organised supervision. The question as to the grades of myrobalans which should be crushed separately would have to be arranged with the Indian suppliers. The increased usage of crushed myrobalans would be promoted if they could be sold on the basis of an analysis made in the United Kingdom.

It is understood that satisfactory machines are available for removing the stones from the nuts, and if this operation were carried out on a large scale in India it might be possible to utilise the kernels of the stones as a source of oil. The kernels are stated to form about 6·5 per cent. of the weight of the stones, and to contain 36 to 37 per cent. of a non-drying oil. On this basis the yield of oil from the stones would be only about 2·5 per cent. It is, therefore, a question for further investigation whether the kernels could be separated from the stones sufficiently cheaply to make the extraction of the oil remunerative. Special machinery for cracking the stones and separating the kernels would probably be required.

### *Future Markets for Myrobalans in the British Empire*

Myrobalans have always been extensively used by British tanners, and before the war the United Kingdom took from 40 to 50 per cent. of the total exports from India. During the war the consumption of myrobalans in the United Kingdom increased considerably, owing to the expansion of the tanning industry, and if this development can be maintained it is probable that larger quantities of myrobalans will be utilised here than in the past. A larger market for myrobalans might also be found in Australia and South Africa for use in conjunction with wattle bark produced in these countries.

The use of myrobalans in the dyeing industry is of less importance than the demand by tanners. It seems probable that the quantity required for dyeing purposes in the United Kingdom will remain fairly constant at the pre-war level.

### *Further Investigations required*

*Terminalia Chebula*, the source of the myrobalans of commerce, is stated to be a very variable tree, and in Hooker's *Flora of British India* six varieties are enumerated, some of which, Gamble suggests, might perhaps be better regarded as species. No information appears to be on record as to whether the fruits of the different varieties

vary greatly in the amount of tannin they contain, and therefore in value as tanning agents. The Committee were of opinion that this important point should be decided, as the facts, when ascertained, will have an important bearing on the future collection and grading of the nuts.

An enquiry on the subject was accordingly addressed to the President of the Forest Research Institute at Pusa. It appears, from his reply, that no systematic study of myrobalans has yet been made in India, but it is agreed that it is very desirable that this should be done. The Forest Botanist proposes to commence the work as soon as possible. The samples of fruit from the different varieties will be sent to the Imperial Institute for examination and tanning trials.

It would also be desirable to carry out further investigations in order to determine finally the best time for the collection of the nuts, i.e. the degree of maturity at which they contain the largest percentage of tannin.

The Committee further suggest that an enquiry might usefully be held in India to investigate the methods generally employed in collecting, drying, grading and storing myrobalans before the nuts come on to the market. It is probable that considerable improvements could be made in the methods now employed with beneficial results to the condition and quality of the nuts. The question of the extended production of crushed myrobalans in India might also be included within the scope of the enquiry.

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*October* 1919.

## MYROBALANS

### TABLE I.—EXPORTS FROM INDIA

| | 1910–11. | 1911–12. | 1912–13. | 1913–14. | 1914–15. | 1915–16. | 1916–17. | 1917–18.[1] | 1918–19.[1] |
|---|---|---|---|---|---|---|---|---|---|
| Total Exports, quantity . cwt. | 1,658,895 | 1,233,661 | 1,397,755 | 1,236,394 | 1,164,261 | 1,392,663 | 1,081,209 | 815,550 | 823,890 |
| Total Exports, value. . £ | 465,097 | 333,520 | 414,280 | 379,626 | 350,450 | 470,157 | 413,103 | 315,303 | 328,936 |
| *To British Empire :* | *Cwt.* | *Cwt.* | *Cwt.* | *Cwt.* | *Cwt.* | *Cwt.* | *Cwt.* | *Cwt.* | *Cwt.* |
| United Kingdom . . . | 681,112 | 486,829 | 686,980 | 504,001 | 644,389 | 937,037 | 796,531 | 717,479 | 655,086 |
| Australia . . . . | 22,365 | 15,222 | 16,047 | 10,597 | 27,273 | 28,142 | 13,404 | — | — |
| Other British Possessions . | 3,656 | 3,875 | 1,111 | 5,743 | 5,438 | 21,960 | 22,690 | — | — |
| Total . . . . | 707,133 | 505,926 | 704,138 | 520,341 | 677,100 | 987,139 | 832,625 | — | — |
| *To Allied Countries :* | | | | | | | | | |
| United States . . . | 298,383 | 224,053 | 191,656 | 187,288 | 189,338 | 267,417 | 133,668 | 40,310 | 49,993 |
| Philippines . . . . | — | — | — | — | 2,188 | — | — | — | — |
| Belgium . . . . | 211,433 | 147,757 | 142,422 | 136,028 | 93,098 | — | — | — | — |
| France . . . . . | 38,707 | 32,697 | 51,803 | 40,814 | 37,393 | 72,358 | 28,516 | — | — |
| Italy . . . . . | 20,109 | 14,459 | 25,948 | 15,436 | 7,713 | 30,302 | 23,245 | — | — |
| Russia . . . . . | 32,324 | 19,980 | 10,188 | 20,731 | 3,945 | 3,934 | 12,094 | — | — |
| Japan . . . . . | 847 | 6,983 | 2,736 | 5,437 | 9,185 | 23,676 | 45,331 | | — |
| Total . . . . | 601,803 | 445,929 | 424,753 | 405,734 | 342,860 | 396,687 | 242,854 | — | — |
| *To Enemy Countries :* | | | | | | | | | |
| Germany . . . . | 304,842 | 233,039 | 228,634 | 270,767 | 121,962 | — | — | — | — |
| Austria-Hungary . . . | 43,112 | 46,842 | 39,647 | 37,302 | 20,964 | — | — | — | — |
| Turkey, Asiatic . . . | 12 | 87 | 68 | 91 | 14 | 25 | 12 | — | — |
| Total . . . . | 347,966 | 279,968 | 268,349 | 308,160 | 142,940 | 25 | 12 | — | — |
| *To Neutral Countries :* | | | | | | | | | |
| Spain . . . . . | — | — | — | — | 1,126 | — | — | — | — |
| China . . . . . | 368 | 40 | 408 | 1,710 | 39 | 2,568 | 966 | — | — |
| Other countries[2] . . . | 1,625 | 1,798 | 107 | 449 | 196 | 6,244[3] | 4,752[4] | — | — |
| Total . . . . | 1,993 | 1,838 | 515 | 2,159 | 1,361 | 8,812 | 5,718 | — | — |

[1] *Full details not yet available.*

[2] *Includes "Other Foreign Countries" in the Indian Trade Returns.*

[3] 5,550 *cwt. to Sweden.*

[4] 4,694 *cwt. to Norway.*

*Note.*—The figures for 1910–11 to 1916–17 are taken from the Annual Statement of the Sea-borne Trade of British India, and those for

## MYROBALANS

### TABLE II.—UNITED KINGDOM TRADE

| | | 1911. | 1912. | 1913. | 1914. | 1915. | 1916. | 1917. | 1918.[2] |
|---|---|---|---|---|---|---|---|---|---|
| *Imports :* | | | | | | | | | |
| Total : | | | | | | | | | |
| Quantity . . | cwt. | 515,216 | 576,624 | 565,222 | 560,600 | 778,984 | 861,729 | 674,377 | 748,130 |
| Value . . | £ | 138,744 | 162,646 | 176,855 | 162,941 | 292,297 | 499,629 | 639,563 | 788591 |
| From India : | | | | | | | | | |
| Quantity . . | cwt. | 511,222 | 572,122 | 564,462 | 559,100 | 770,906 | 860,871 | 674,377 | — |
| Value . . | £ | 137,670 | 161,438 | 176,621 | 162,413 | 289,577 | 499,290 | 639,563 | — |
| *Re-exports :* | | | | | | | | | |
| Total : | | | | | | | | | |
| Quantity . . | cwt. | 7,986 | 14,698 | 22,003 | 14,270 | 24,511 | 35,479[1] | 761 | 4,460 |
| Value . . . | | 2,491 | 4,531 | 6,277 | 5,232 | 12,055 | 26,797 | 556 | 4,749 |

[1] 18,527 *cwt. to Netherlands as against* nil *in* 1912 *and* 1913.

[2] *Full details not yet available.*

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